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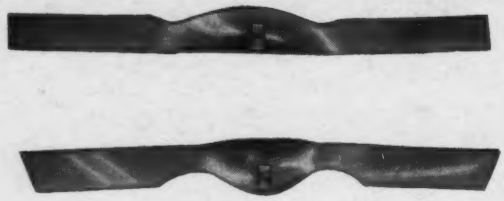

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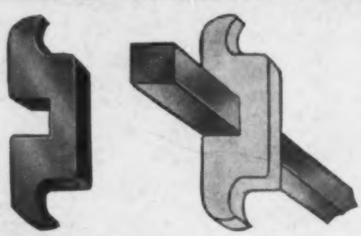

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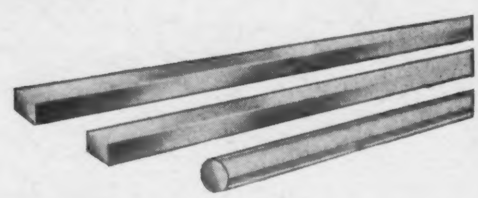

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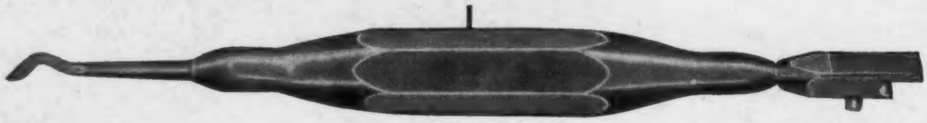

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(Editorial and Business Communications on inside back cover)

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Vol. 45 June, 1959 No. 6

Original Articles

OBSERVATIONS ON FACIAL GROWTH AND ITS CLINICAL SIGNIFICANCE

Alton W. Moore, D.D.S., M.S.,* Seattle, Wash.

> May the progress of the past be our encouragement for the future; ...may we—may our profession—labor hand in hand; some cultivating principles already planted till they grow up to perfection—others exploring new fields and developing new principles, each pursuing that for which nature and the circumstances of life have fitted him—all aiming at that mutual improvement which alone is capable of elevating the profession. While thus striving, may we cultivate a laudable spirit of emulation, a spirit of generous rivalry; but may we never mar the interests of our cause by professional jealousy, nor cripple its energies by professional selfishness.
>
> —*George Watt, M.D., D.D.S.*

The above quotation could well be adopted by the orthodontic profession as its creed. As a profession, orthodontics is just now coming of age. Some of you may be startled by this statement and point out that it has been a specialty of dentistry since the turn of the century some fifty-eight years ago. This can be countered with the fact that as an academic discipline for the education of men to practice orthodontics exclusively, it was first introduced into a university atmosphere in 1923, a short thirty-five years ago. Ten years ago

Presented at the thirty-seventh annual meeting of the Southern Society of Orthodontists, Bermuda, Oct. 19-24, 1958.

*Professor and Head of the Department of Orthodontics, University of Washington, School of Dentistry.

dentistry celebrated the centennial of its entrance into academic life. Thus it has had time to develop a firm foundation of basic knowledge and applied science upon which to base its future.

The development of the profession of orthodontics prior to 1930 was in the hands of individuals rather than institutions. Great advances were made under the leadership of these men, but unfortunately personality clashes often hindered rational thinking throughout the profession. The profession was divided into camps, with the leaders dictating the thoughts and actions of their followers. Appliances and systems were the chief concern of the day, and for the most part little thought was given to the development of a sound foundation of basic knowledge. With the passing of these leaders and the entrance of orthodontics into university life, the former camps of divergent beliefs have all but disappeared. The profession has become more discerning and now evaluates new ideas and concepts on the basis of their scientific merit rather than in terms of personal feelings about those who introduce the ideas.

In this discussion I do not intend to be critical of our forebears. I mean, rather, to point out a few of the resultant evils that accompany individual domination of any science. These leaders gave us the base upon which our profession stands and upon which has been built our present knowledge. Without them we would never have reached our present level of clinical competence. For our future, however, the objectivity of academic discipline provides the best pathway for the rapid advancement of our basic science background and its application to clinical knowledge. If we are to maintain our status as a profession, we must place our future academic development exclusively in the hands of the universities. Falling short of this will jeopardize our professional standing and allow personal feelings or prejudice to continue to dominate our advancement.

In recent years the emphasis on appliances has gradually shifted to a greater concern for knowing the reasons why and for the development of knowledge that will enable us better to serve our patients. In 1952 Waldo[1] wrote:

> The effective use of good appliances is as essential to orthodontics as breathing is to living. It is a means to an end, however, not an end in itself, and our real problems do not lie in that area. The real problems that face us are those of growing up professionally; of accepting our professional maturity and responsibilities. If we are to do this, we need to be less preoccupied with gadgets and more concerned with concepts and ideas. We should quit chasing that "will-o'-the-wisp," a system of treatment that will give us the answers ready-made, and accept the inescapable fact that thought and reasoning are essential to good orthodontics.
>
> We must, above all, accept our responsibilities as a profession if we want to remain one. For a long time, orthodontics has been regarded as a young and growing profession, both by ourselves and by the public. Society will not tolerate childishness after childhood has passed. Our acceptance of maturity will determine whether orthodontics is to be a profession or a trade; a public benefactor or a public ward.
>
> As a first step in a practical approach to our problems, we must break away from a narrowness of thought that inevitably afflicts members of a specialty within a specialty. We must readjust our sense of values, if necessary, and take a fairly comprehensive look

at orthodontics and orthodontists; try to see what it is we want to be and what we want orthodontics to be; what we want to do and how we can do it best under the limitations of our knowledge and abilities and the conditions imposed by nature and circumstance.

The answer to our clinical problems lies not in the development of better appliances but, rather, in a fuller understanding of craniofacial growth and its clinical implications. An attempt will be made in this article to report some recent observations on facial growth and to analyze their clinical effect. Many concepts and theories have been proposed, accepted, and then discarded during the past sixty years with regard to orthodontic diagnosis and treatment procedures. Some of these concepts have actually hampered and held back the advancement of clinical knowledge and practice. Others have held sway for a short period of time while they were in vogue and then have been forgotten upon the advent of a new concept or method of approach. A few have survived the test of time.

Too often acceptance of a new philosophy by the profession has been based upon the strength and personality of the person developing it. "Armchair theorizing" has a place in the development of sound concepts, provided that the concept developed is compatible with all the facts known at the time. It follows that the man who speculates and offers his speculations as a valid concept has an obligation to be thoroughly familiar with all known facts of his time pertinent to his subject. Unfortunately, this has not always been the case. Once a new theory has received general acceptance, it "dies hard" when evidence is produced to refute it. The theory of "bone growing," for example, is still being held valid and influences orthodontic thinking in scattered segments of the profession.

A subject that has received concentrated attention by authors of orthodontic articles and books has been the morphology, etiology, diagnosis, and treatment of the Class II malocclusion. In studying this subject, there has been a tendency to generalize and to lump all individual patients with the common characteristics of the Class II malocclusion into one group. Today, through roentgenographic cephalometry, we have been made aware of the infinite varieties of facial types that have in common the characteristics of Class II malocclusion. We now realize that a Class II malocclusion can be found in a mesognathic as well as in a retrognathic type of face. In the past, the Class II malocclusion has been associated with a short or retrusively positioned mandible, a large or forward-positioned maxilla, or a combination of several of these factors. Once and for all, we should separate the various factors that are associated with the clinical entity which we call Class II malocclusion. We must remember that Angle's classification of malocclusion was a description of common characteristics of tooth relationship only. There is no need to define Class II malocclusion for this audience, but it might be worth while to emphasize that Class II refers to tooth relationship and in no way implies one particular interrelationship between the maxilla and the mandible.

One often hears a malocclusion described as a "true Class II," meaning that the person has a retrognathic profile outline. A retrognathic face is, of

course, positively correlated with Class II malocclusion, although it is not 100 per cent correlated. We should all be aware of the variations that exist in the interrelationships of the various bones that comprise the facial complex and go to make up a retrognathic face. Once we are familiar with the variations, then an understanding of the growth patterns of such faces is necessary before we can truly understand our treatment problems.

It is the purpose of this article to illustrate some of the known principles of growth and to point out how they influence the development of the so-called facial pattern. We will then be in a position to evaluate the factors associated with the result achieved through orthodontic therapy. Several examples of the developing facial patterns of children growing with and without orthodontic therapy will be presented. The orthodontically treated children all had Class II malocclusions.

First, a review of the facial growth sites is in order before an analysis is made of their effects upon facial development. Fig. 1 illustrates the growth sites that in the past have been commonly stressed in orthodontic considerations of facial growth.

Within the maxilla there are three primary areas of growth; these are located at the superior margin of the frontonasal process, the maxillary tuberosity, and the alveolar process. Growth at the tip of the frontonasal process increases the height of the maxilla and thus adds to the vertical development of the face. The same is true for growth of the alveolar process brought about by eruption of the maxillary teeth. Deposition of bone at the maxillary tuberosity adds to the depth of the face and positions the anterior portion of the maxilla forward in relation to cranial landmarks.

The mandible also increases in size primarily through growth at three different areas—the alveolar process, the condyle, and the posterior border of the ramus. The mandibular condyle adds to both the height and the length of the facial complex because of its orientation to the mandibular body. The growth at the posterior border of the ramus adds to the posterior over-all depth of the face. Deposition of bone on the alveolar process through the eruption of the mandibular teeth also adds to the anterior and posterior vertical height of the face.

All of these growth sites within the maxilla and mandible grow by surface appositional bone formation with the exception of the mandibular condyle. The condyle grows primarily through the proliferation and conversion of cartilage into bone. This is a more rapid type of bone development, and the need for it becomes apparent when it is recognized that growth at this area contributes to both the height and the depth of the face.

At this time, for your consideration, I would like to share with you some recent speculations which represent an attempt to provide an anatomic explanation for some of the observations concerning facial growth that have been made in the past. Björk[2] and others have pointed out the changes that occur in the cranial base angle as part of the process of growth. Those who have reported these changes have all failed to find any consistency in the direction or amount of such change that would make them predictable.

A recent study by Kraus, Wise, and Frei[3] failed to show a morphologic duplication of the facial patterns of monozygotic twins. However, when these same individuals were studied by breaking down the various profile outlines of the bones of the face, almost complete duplication was observed. This establishes the fact that the morphologic traits of the individual bones are genetically determined. The differences in the facial patterns between monozygotic twins were due to the way the various similar bones were oriented to one another. It may be deduced from this observation that even though we have identical genetic patterns for the individual bones themselves, their subsequent development and orientation to one another may be influenced by

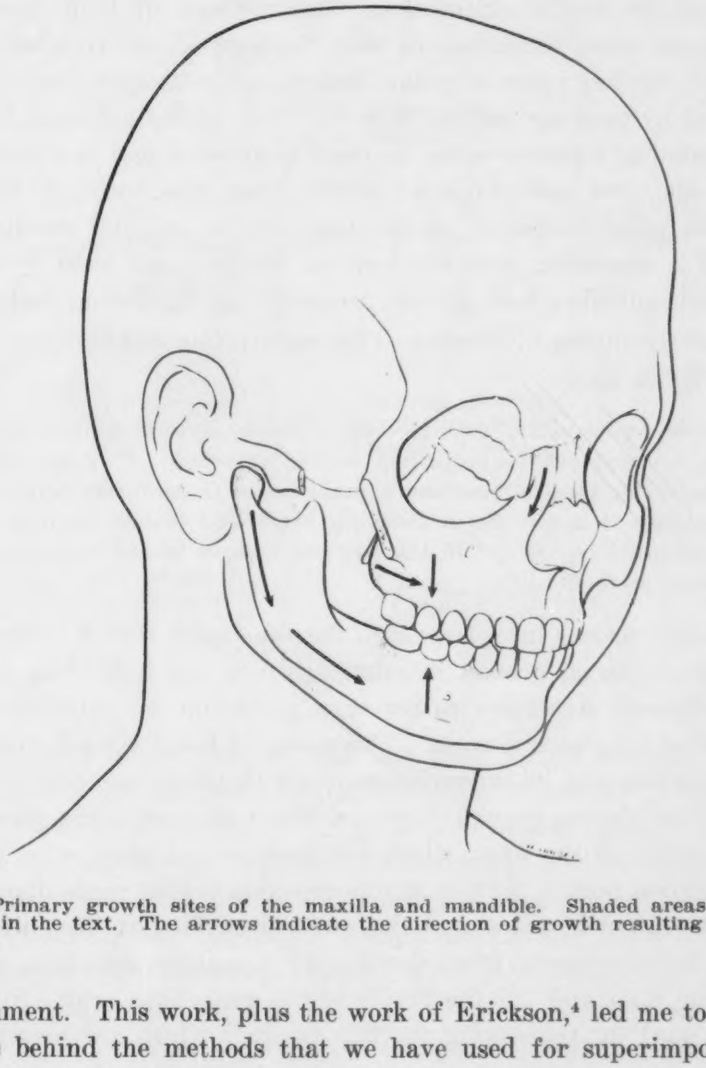


Fig. 1.—Primary growth sites of the maxilla and mandible. Shaded areas indicate the sites described in the text. The arrows indicate the direction of growth resulting from growth at these sites.

their environment. This work, plus the work of Erickson,[4] led me to reconsider the rationale behind the methods that we have used for superimposing serial headfilms in the study of facial growth. The two methods that have been most commonly used in growth studies have been Broadbent's[5,6] Bolton plane with registration point and the method that Brodie[7] has preferred, the sella nasion plane. Broadbent prefers the Bolton plane because it represents to him the

entire cranial base and he has found that sella turcica moves upward and backward in relationship to "R" point during growth. Brodie has used the sella nasion plane in that it represents to him the anterior cranial base to which the face is "hafted" and it is formed by two easily located points. It might be pointed out that if sella rises during growth in relationship to point "R," it follows that point "R" descends down and forward during growth in relation to sella.

It is generally agreed that the most desirable characteristic of any method of serial registration of cephalometric headfilms is a location that is relatively stable or nongrowing. The over-all effect of growth may be observed in relation to this area. The accuracy of such observations is then a function of the degree of stability of the site of orientation. The methods of both Broadbent and Brodie have the same limitation in that the methods of registration are dependent upon another point or points located some distance from sella turcica and separated by growing sutures from the body of the sphenoid bone. Point nasion is located in a suture which in itself is growing and is separated by the sphenoethmoidal and sphenofrontal suture from the body of the sphenoid bone. Bolton point is located at the base of the occipital condyle which is growing and is separated from the body of the sphenoid bone by the spheno-occipital synchondrosis where growth proceeds rapidly during early childhood.

Moss and Greenberg,[8] referring to the registration techniques of Broadbent, Brodie, and Björk state:

> All of these cephalometric techniques are primarily directed toward problems of the growth of the dentition and its supporting osseous structures. They are not capable, as now used, of indicating morphological and spatial changes in the tissues between the selected points of reference. It is felt that a technique which used contour tracings of the actual anatomical units would be useful. In this way the changes in and between these growing units could better be studied.

Recent observations have led me to the conclusion that it might be well to attempt to study facial growth in relationship to one individual bone and its immediate adjacent structures rather than points on several distantly located bones separated by growing areas. The sphenoid bone was selected because of its central location and its interrelationship with all the bones of the face and cranium.* Since, during growth, there are slight changes in the contour of sella turcica, the center of the fossa, which has been termed point sella, was selected as the registration point. Maximum superposition is then made upon the profile outline of the sphenoid plane and the cerebral surface of the anterior cranial fossa. The latter presents two aspects: (1) a midline structure representing the cribroform plate and (2) the profile of the roof of the orbit (Fig. 2). This method was used for registering the film tracings which are presented in this

*Since the preparation of this paper, an intensive serial study has been made of the cranial base in an attempt to locate its most stable areas. The results of this study will be reported in the near future. The method of registration developed as a result of this new study varies in detail from the present one, but the interpretations drawn in the present paper remain relatively unchanged from those drawn after utilizing the newer method.

article. These structures in profile outline, during the growth period studied, proved to be remarkably stable. The peripheral points on the skeletal profile of the face varied according to the rates and amounts of growth at the various facial growth sites. This is consistent with previous observations that all bones do not grow at the same time or at the same rate.

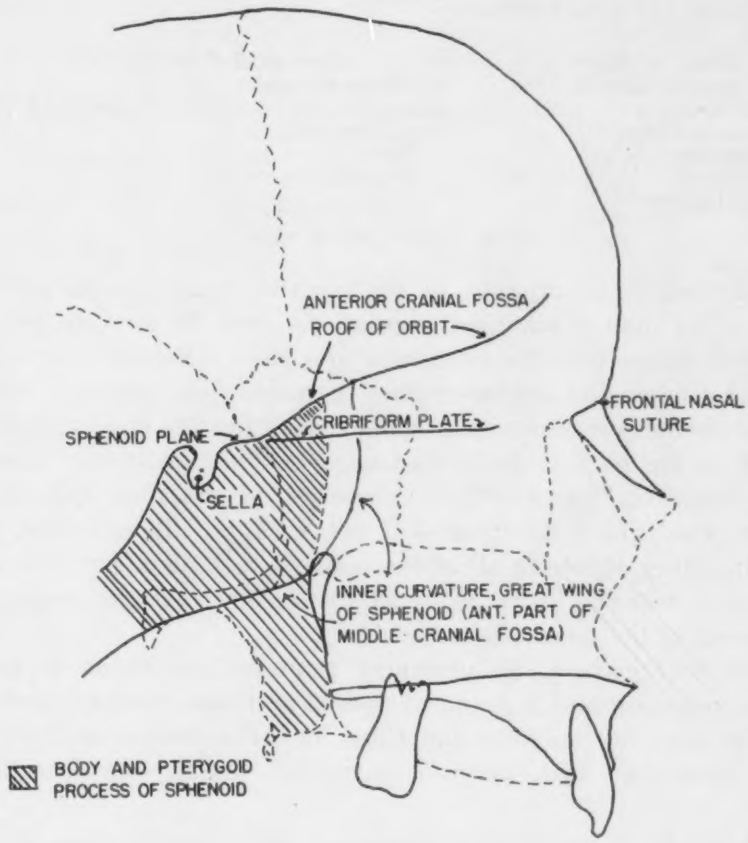


Fig. 2.

One concept of facial growth that has been widely quoted but rarely understood in the orthodontic literature is that of the "constancy of the pattern." This concept developed out of the studies of Broadbent and Brodie. The general interpretation of this concept has been that facial growth is always an even and orderly process. Such an interpretation of this concept is completely erroneous and does nothing but lead to confusion when one tries to understand any given person's growth pattern. Such a strict interpretation applies to the population *only* and seldom, if ever, to an individual. The development of the facial pattern is governed by the effect of different rates at the various growth sites of the facial complex. These growth sites may be divided into those that contribute to the vertical planes and those that contribute to the horizontal planes of space when the head is viewed in norma lateralis (Fig. 3).

With this number of growth sites being responsible for the enlargement of the facial complex, it becomes apparent that the relative locations of the various sites to each other and the rates and amounts of their growth will determine the final facial pattern to be developed. If, through orthodontic procedures, we can alter favorably the rate of growth or affect the relationships of the various growth sites to one another, we have within our power the ability to change the facial pattern.

Vertical Plane of Space	*Horizontal Plane of Space*
Frontal process, maxilla	Maxillary tuberosity
Maxillary eruption	Anteroposterior position of pterygoid plates
Mandibular eruption	Mandibular condyle
Mandibular condyle	Position
Position	Horizontal growth
Vertical growth	

Fig. 3.—Facial growth sites.

The following is an attempt to analyze the facial growth process in a qualitative rather than a quantitative manner. Such an analysis requires the use of the eyes rather than the protractor and ruler. Recently there has been too much of a tendency to measure rather than study our patients. The application of pat formulas without analysis has tended to stifle creative and analytical thinking on the part of the orthodontist and has made him a slave to a false god. Individual cases will be presented to see what can be learned regarding growth. They are presented not with the thought that they are typical, or that they represent all of the possible variations, but with the hope that they might make us more aware of the factors that are responsible for the development of the facial pattern.

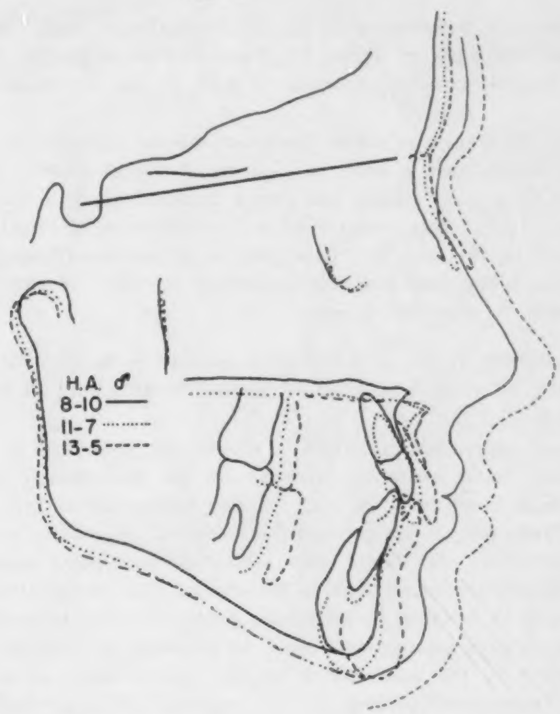
The first four cases to be presented represent variations in growth of children who possessed and maintained normal occlusion throughout the period studied. The next five subjects had Class II malocclusions and were under orthodontic treatment with cervical anchorage during the growth period recorded.

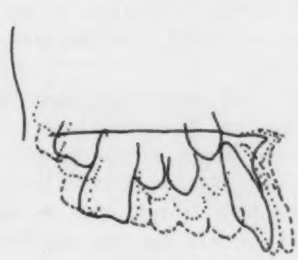
Three methods of registration were used for analyzing these cases. The method previously described, utilizing the cranial base, was used for an overall evaluation of the effects of growth. This will be referred to as the over-all registration. The maxilla and mandible were each registered separately in order to illustrate their separate growth processes. The standard mandibular registration was used—registration on menton, which is the most inferior point on the mandibular symphysis, and on a line connecting this point to the most inferior portion of the posterior part of the mandibular body. The maxilla was registered upon the anteroposterior position of the pterygomaxillary fissure, and the palatal plane was superimposed. This method of registering the maxilla was selected as it graphically illustrates the effect on the facial profile of growth in length of the maxilla and the eruption of the maxillary teeth.

Case 1.—The patient is H. A., a boy with normal occlusion. Growth between the ages of 8 years 10 months, 11 years 7 months, and 13 years 5 months is shown in Figs. 4, 5, and 6.

The cranial registration (Fig. 4) reveals that there has been marked growth of the face in a vertical direction between the ages of 8 years 10 months and 11 years 7 months, with very little growth in the anteroposterior depth of the face. Between 11 years 7 months and 13 years 5 months, we observe a shift in the pattern of growth with practically no vertical development but marked anteroposterior dimensional change. A further study of this illustration partially explains the shift in the growth pattern. There have been marked

Fig. 4.





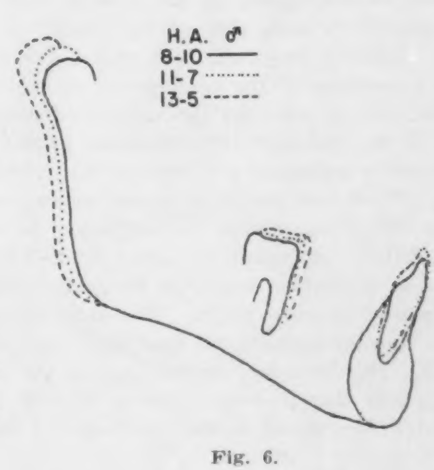


Fig. 5.

Fig. 6.

growth of the frontonasal process and increase in the anteroposterior depth of the body of the maxilla; this has caused the occlusal plane to be placed at a much lower level in relation to the cranial base, in spite of the fact that there has been no actual increase in denture height (Fig. 5). The mandible must precede the maxilla in its descent. Between

the ages of 11 and 13 there has been no increase in the length of the frontonasal process or in the denture height, so that all of the maxillary tuberosity growth has expressed itself in a forward direction.

A study of the maxillary superposition (Fig. 5) shows that there has been no increase in the vertical denture height between the ages of 8 and 13 years. The maxilla has grown in length between each of the periods and has carried the denture with it. The premolars and cuspids have erupted downward and forward to the occlusal plane in relation to the tuberosity.

The mandibular registration (Fig. 6) illustrates a slight increase in vertical denture height. Between the ages of 8 and 11, there was some growth of the mandibular condyle in length and height; however, between 11 and 13 the increment of growth posteriorly al most doubled.

Combining the results of these three methods of registration enables one to understand the method by which such a shift in pattern of facial growth can be effected. It is of interest to note that point nasion has grown forward along a line drawn from sella to the original nasion. It has thus maintained a constant vertical relationship to the cranial base registration used in this study. This pattern is not manifested in all persons, however. It should also be noted that the anteroposterior position of the pterygomaxillary fissure is relatively constant to the cranial base.

Case 2.—Patient C. N. is a boy with normal occlusion. Growth between the ages of 7 years 7 months, 10 years 2 months, 12 years 2 months, and 14 years 2 months is shown in Figs. 7, 8, and 9.

The over-all superposition (Fig. 7) shows that this face is developing downward and forward in about equal amounts. Growth of the frontonasal process has positioned the palatal plane on a lower level on each of the subsequent stages of development. Between the 10- and 12-year stages the vertical increment of growth is about twice that of the anteroposterior direction. It should also be noted that point nasion is not maintaining a constant vertical position in relation to the cranial base registration but is descending downward and forward in relation to its initial position. This is readily explained by the fact that it is a suture area and growth could be expected on both sides of the suture, namely, deposition of bone in the nasal notch of the frontal bone as well as on the end of the approximating frontonasal process of the maxilla. The vertical movement of this point during growth in relationship to the cranial vault would be dependent upon the relative amount of growth on each side of the suture as well as its orientation to the internal cranial base. Using a line from sella nasion for registration in this particular case would give a false impression of the development of this facial pattern. Even though this represents only one case, it rules out the validity of using the sella nasion plane as a method of registration in the evaluation of *individual* growth patterns. Note also that the pterygomaxillary fissure is maintaining a constant horizontal position in relation to the cranial base registration. If we used the sella nasion registration, we would have the erroneous impression that the fissure was moving downward and forward.

The maxillary superposition (Fig. 8) indicates that there has been practically no vertical increase in denture height in the incisor region, but there has been some slight increase in posterior denture height. The anteroposterior length of the maxilla increased a much greater amount between the ages of 7 and 10 and 12 and 14 than between the ages of 10 and 12. This maxillary growth carried the maxillary denture with it, and the slight amount of growth that occurred between 10 and 12 accounts for the maxillary premolars erupting straight downward in that they started to erupt when the maxilla was not in an active growth stage.

The mandibular superposition (Fig. 9) shows that the mandibular denture has erupted during the entire period of development. The mandibular incisors have been positioned upward and backward as they erupted. The mandibular condyle and ramus have grown upward and backward, with the greatest increment of growth occurring in the last stage between 12 and 14 years of age.

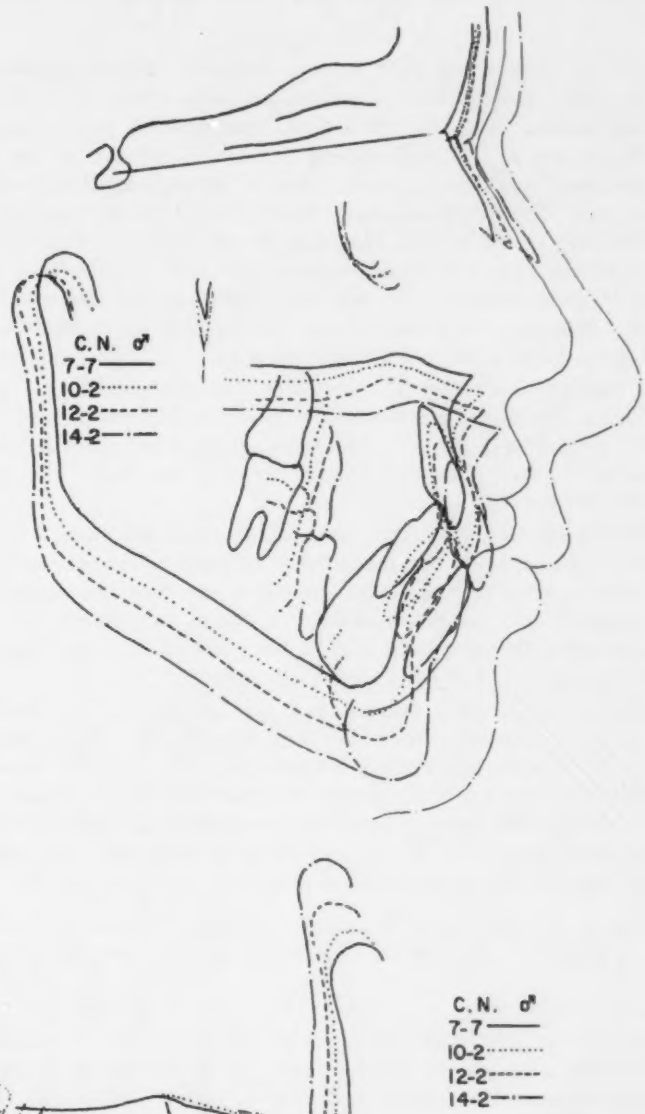


Fig. 7.

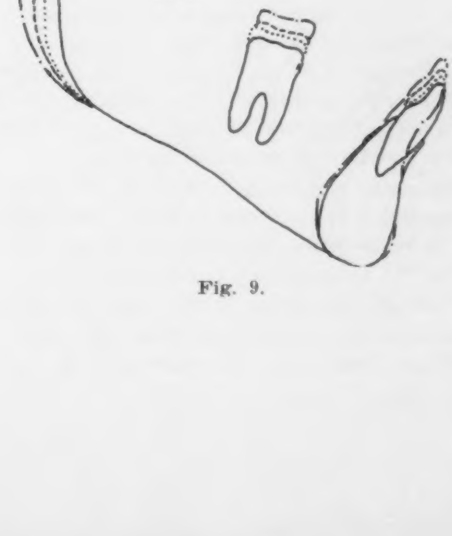


Fig. 8.

Fig. 9.

This case exhibits a different pattern of growth from the first one shown. Again, it should be noted that variation in the rates and amount of growth of the several growth sites and the interrelationship of these sites produce variations, not constancy, in the developing facial pattern.

CASE 3.—Patient J. C. is a boy with normal occlusion. Growth between the ages of 8 years 9 months, 11 years 3 months, and 13 years 3 months is shown in Figs. 10, 11, and 12.

The over-all registration (Fig. 10) shows the face growing predominantly downward in relationship to the cranium. There has been a marked increase in the length of the frontal process of the maxilla which has caused descent of the maxillary palatal plane. It also can be observed that the pterygomaxillary fissure, which usually maintains a constant anteroposterior relationship to the cranial base, has moved forward. This would mean that the functional length of the maxilla is being increased not only by growth of the bone itself but also by its more forward position. We also can observe in this illustration that vertical ramus growth has not kept pace with the vertical development of the anterior part of the face, and hence the mandibular plane has become steeper.

The maxillary superposition (Fig. 11) indicates that the maxilla has grown forward and that the teeth have shown marked vertical eruption and forward positioning in relationship to the pterygomaxillary fissure. The greatest forward growth occurred in the earliest period between 8 years 9 months and 11 years 3 months. The premolars have erupted downward and forward.

The mandibular registration (Fig. 12) shows that there has been a marked increase in the vertical denture height, with the mandibular incisors being positioned upward and backward. There has been marked mandibular growth in the condylar region, with approximately equal increments in both periods studied. It should be pointed out, however, that the condylar growth between the ages of 8 and 11 has been upward and backward, whereas between the ages of 11 and 13 it has been almost all upward.

This case illustrates the growth factors that play a part in the development of a retrognathic type of face. Nasion has maintained a relatively stable vertical position. However, its distance from sella has increased markedly. The relative forward movement of the maxillary tuberosity, coupled with increase in maxillary length, could only result in the development of a retrognathic pattern unless the mandibular growth increments were far above average, which they were not. It is interesting to note that the occlusion has remained "normal" throughout the growth period observed.

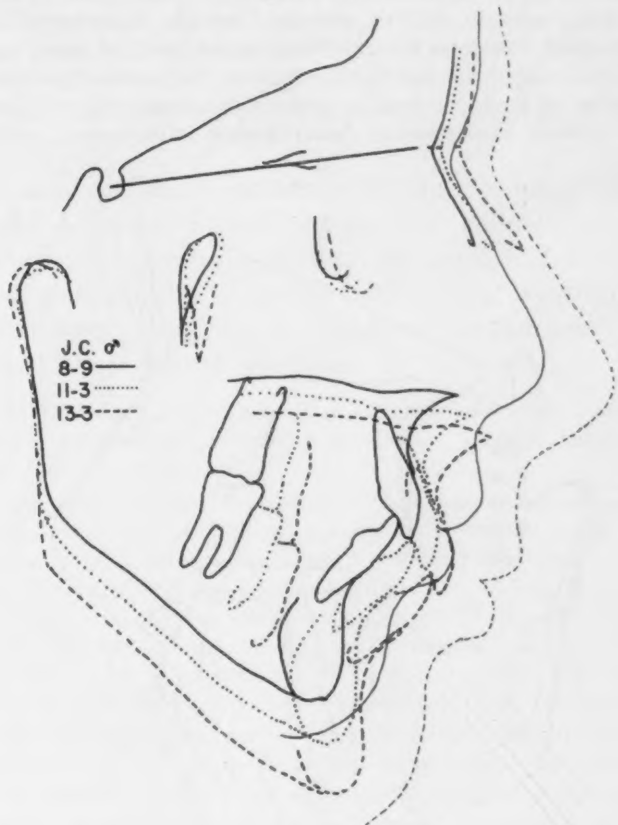
CASE 4.—Patient G. W. is a boy with normal occlusion. Growth between the ages of 8 years 9 months, 11 years, 12 years 2 months, and 13 years 3 months is shown in Figs. 13, 14, and 15.

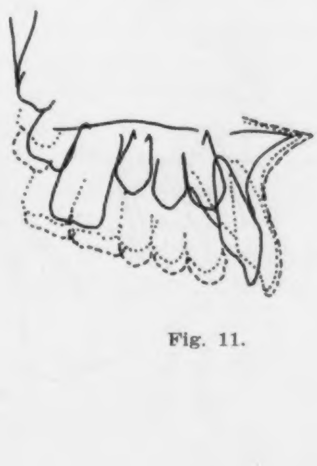
The over-all superposition (Fig. 13) shows a face that is growing predominantly in a vertical direction. Growth of the frontonasal process has positioned the palatal plane at a much lower level in relationship to the cranial base. It is interesting to note that there has been little growth between the eleventh and twelfth years. The horizontal position of the anterior portion of the maxilla has maintained a rather constant relationship with the cranial base from the eleventh year onward. The vertical increments of growth far outweigh the anteroposterior increments. The pterygomaxillary fissure has maintained a relatively constant anteroposterior relationship to the cranial registration. A statement cannot be made regarding behavior of point nasion in that this particular patient did not have a visible suture junction in the nasal region.

The maxillary registration (Fig. 14) shows that there has been some vertical eruption of teeth, especially in the molar region. The maxilla has increased in length between the eighth and eleventh years, but between the eleventh and thirteenth years there was virtually no change in the anteroposterior dimension. This accounts for its relatively constant horizontal position in relationship to the cranial base.

The mandibular registration (Fig. 15) shows that the incisors are erupting and are being positioned posteriorly in relationship to the body of the mandible. The posterior

Fig. 10.





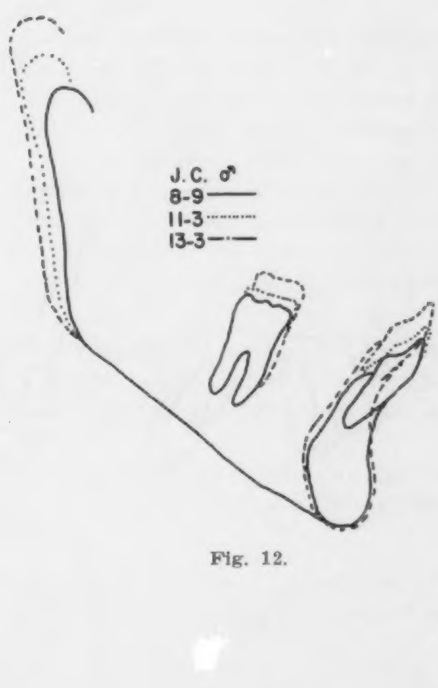


Fig. 11.

Fig. 12.

teeth show evidence of continual eruption during the growth period studied. The mandible has increased in length and height through ramus and condylar growth. The increment of growth is about equal in the horizontal and vertical directions. The amount of condylar growth was much greater in the first and third periods as contrasted to the second period.

This case again illustrates that variation in the rates of growth of the several growth sites may profoundly alter the interrelationships of the various bones of the face.

At this point it might be well to contrast this case (Fig. 13) with Case 1 (Fig. 4). Both of these children have pleasing facial skeletal patterns and soft tissue profiles, from

Fig. 13.

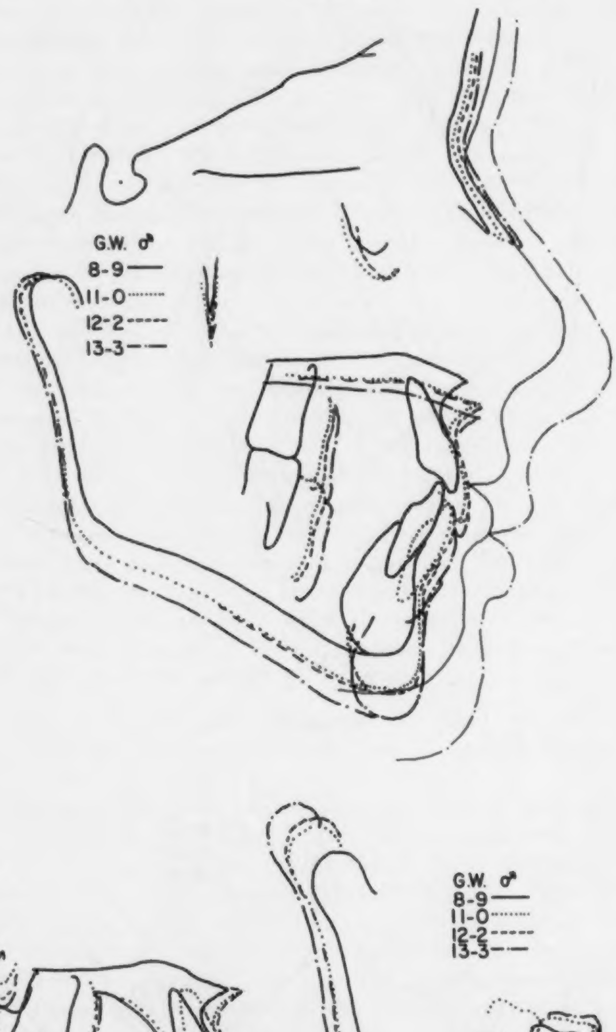


Fig. 14.

Fig. 15.

the orthodontist's point of view, and are maintaining them through the developmental period. The growth patterns of these cases are entirely different; Case 1 is growing predominantly forward whereas Case 4 is growing predominantly downward. This illustrates the point that growth in depth of the face is not necessarily more desirable than vertical development, from the orthodontic point of view. The difference between favorable and unfavorable growth from an orthodontic point of view may perhaps best be explained in terms of individual bone morphology, bone interrelationships, and differential growth rates. These three phenomena are interdependent.

After noting some of the variations that may be observed in growing children with normal occlusion, we may observe some children who had Class II malocclusions. During their growth, a distal restraint had been placed upon the maxillary first permanent molars through cervical anchorage. Keep in mind what has been observed in growing children who had excellent occlusions but varying types of facial growth patterns.

Case 5.—Patient E. J. is a boy with a Class II, Division 1 malocclusion. Growth between the ages of 9 years 10 months, 10 years 9 months, 11 years 10 months, and 13 years 5 months is shown in Figs. 16, 17, and 18.

The over-all superposition (Fig. 16) reveals a face that is developing predominantly in a vertical direction. With this method of registration it can be noted that there is a gradual descent of the palatal plane away from the cranial base due to growth at the proximal end to the frontonasal process of the maxilla. It also can be observed that the relative anteroposterior position of the anterior portion of the maxilla has maintained a rather constant relationship with the cranial base. The mandible is further forward at the last stage, however, when it is related to the total facial profile. The pterygomaxillary fissure has maintained a constant anteroposterior relationship with the cranial base during the growth period studied. Point nasion relative to its initial position has moved forward and slightly downward in relationship to the cranial registration. The possible mechanism of this was discussed previously. From an orthodontic point of view, there has been a favorable change in the facial pattern during the growth period studied. Note that the Class II molar relationship has been changed to Class I.

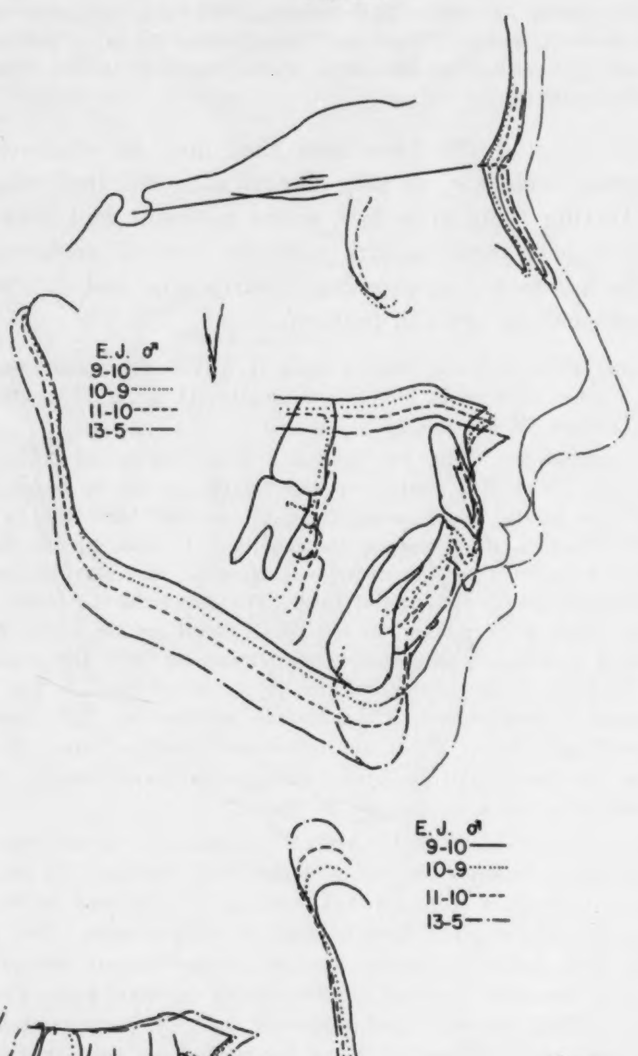
The maxillary superposition (Fig. 17) reveals no change in the anteroposterior position of the anterior nasal spine between the first and the third tracings. In the fourth tracing this point is observed to be in a more forward position. It also may be observed that the teeth in relation to the palatal plane have behaved in various ways. The molar was first moved distally with little vertical eruption; then it descended more vertically, so that its final relationship is in the same relative anteroposterior position from whence it started. The premolars have erupted downward and backward and then were carried forward. The incisors have descended only vertically. It is interesting to note that there has been negligible increase in the anteroposterior length of the denture area proper during the entire period studied.

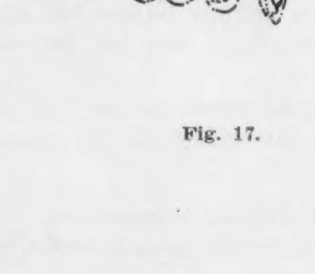
The mandibular superposition (Fig. 18) reveals marked upward and backward growth of the condyle. The increments of growth are fairly uniform between the ages studied. There has been some eruption of the mandibular anterior teeth, with very little eruption of the mandibular first permanent molar.

This case is an example in which an individual facial growth site may have been altered through orthodontic therapy, thus producing a desirable change in the patient's facial pattern.

Case 6.—Patient T. T. is a girl with a Class II, Division 1 malocclusion. Growth between the ages of 9 years 6 months, 13 years 4 months, and 14 years 2 months is shown in Figs. 19, 20, and 21.

Fig. 16.





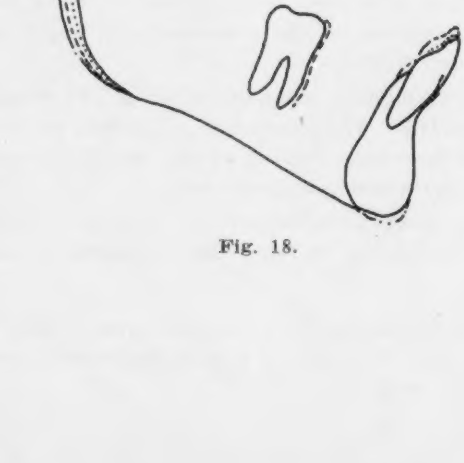
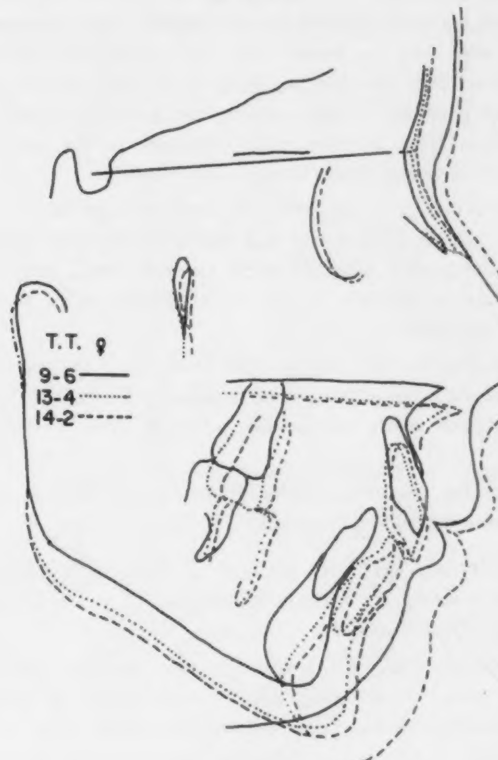


Fig. 17. Fig. 18.

Fig. 19.



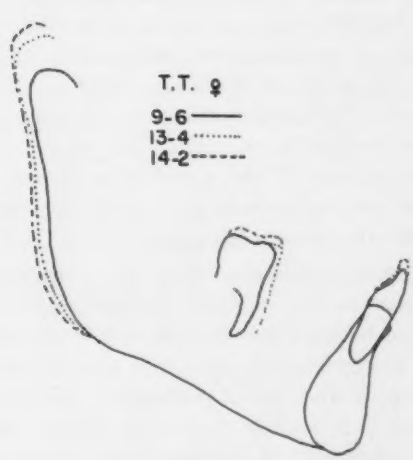


Fig. 20.

Fig. 21.

The over-all registration (Fig. 19) shows a face which has grown from a retrognathic one to a more mesognathic profile. There was an increase in nasal height between the ninth and thirteenth years, but no increase was evident in this measurement between the thirteenth and fourteenth years. The anterior portion of the maxillary denture area has maintained a relatively constant anteroposterior relationship with the cranial base. The tip of the anterior nasal spine moved forward relative to the cranial base between the thirteenth and fourteenth years, but it also may be noted that the pterygomaxillary fissure also moved forward at the same time. The mandibular chin point has moved markedly forward in relationship to its original position. Point nasion has grown forward and has maintained a relatively stable superior-inferior position with reference to the cranial registration. The molar relationship has been changed from Class II to Class I.

The maxillary registration (Fig. 20) reveals little change in the anteroposterior position of the anterior nasal spine. This would indicate a negligible amount of growth of the maxilla in length during the period studied. The anterior teeth have erupted slightly, but the posterior teeth illustrate a greater degree of eruption. The premolars have erupted primarily downward and backward.

The mandibular registration (Fig. 21) illustrates that the ramus and condyle have grown in length and in height during the period studied. There has been some eruption of both the posterior and anterior teeth which have added to the vertical development of the face.

This case also illustrates an orthodontically favorable change in the facial pattern brought about by growth plus orthodontic therapy.

Case 7.—Patient M. H. is a girl with a Class II, Division 1 malocclusion. Growth between the ages of 9 years 4 months, 10 years 3 months, 11 years 10 months, and 14 years 3 months is shown in Figs. 22, 23, and 24.

The over-all registration (Fig. 22) reveals a face growing predominantly vertically, with the mandibular chin point positioning progressively more forward in relationship to the total profile. The palatal plane has progressively descended away from the cranial base, increasing the vertical height of the face. Between the ninth and tenth years the mandible has descended vertically without moving forward, between the tenth and eleventh years it has moved markedly forward as well as downward, and between the eleventh and fourteenth years it has moved predominantly downward. The relative anteroposterior relationship of the pterygomaxillary fissure to cranial registration has remained stable between the ninth and eleventh years; however, between the eleventh and fourteenth years we note that it is positioned more forward in the face. The effect of this forward movement can be observed in the relative position of the anterior nasal spine. It should be noted that nasion has grown forward but has maintained a relatively stable verticle relationship to the cranial base. Note also the change from Class II to Class I in the molar relationship.

The maxillary registration (Fig. 23) reveals no growth in the anteroposterior length of the maxilla between the ninth and eleventh years. However, there has been a slight increase in this dimension between the eleventh and fourteenth years. For one year prior to the last film, or at the fourteenth year level, this patient had not been wearing the maxillary cervical strap. The incisors were moved posteriorly between the ninth and eleventh years and were carried forward with maxillary growth between the eleventh and fourteenth years. The maxillary first permanent molar was originally moved distally, had erupted, and then was subsequently carried forward. The premolars erupted downward and backward in relation to the palatal plane. The anterior teeth erupted very little during the period studied. However, the molars exhibited a considerable amount of vertical eruption.

The mandibular registration (Fig. 24) indicates that the mandible has grown in length and height through growth at the posterior border of the ramus and of the condyle.

The increments of growth between the various stages studied are relatively equal. The mandibular molars maintained a rather constant superior-inferior position for the first three stages and then erupted vertically between the eleventh and fourteenth years. The incisors erupted a slight amount.

This case is another example of facial growth that has been favorably influenced through orthodontic therapy and exhibits a marked change in facial pattern.

Fig. 22.

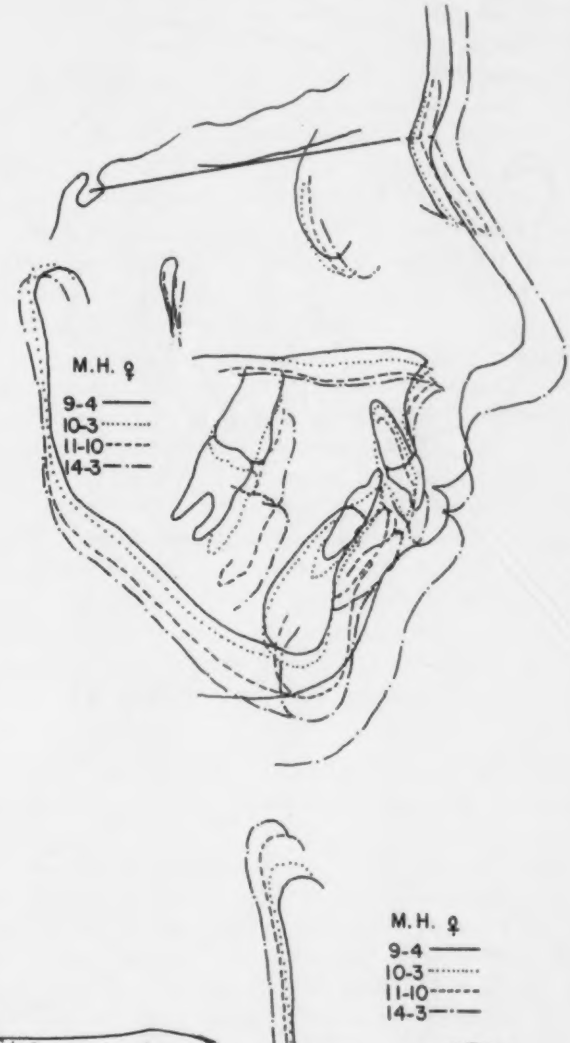


Fig. 23.

Fig. 24.

CASE 8.—Patient B. T. is a girl with a Class II, Division 2 malocclusion. Growth between the ages of 9 years 7 months, 11 years 2 months, and 12 years is shown in Figs. 25, 26, and 27.

Fig. 25.

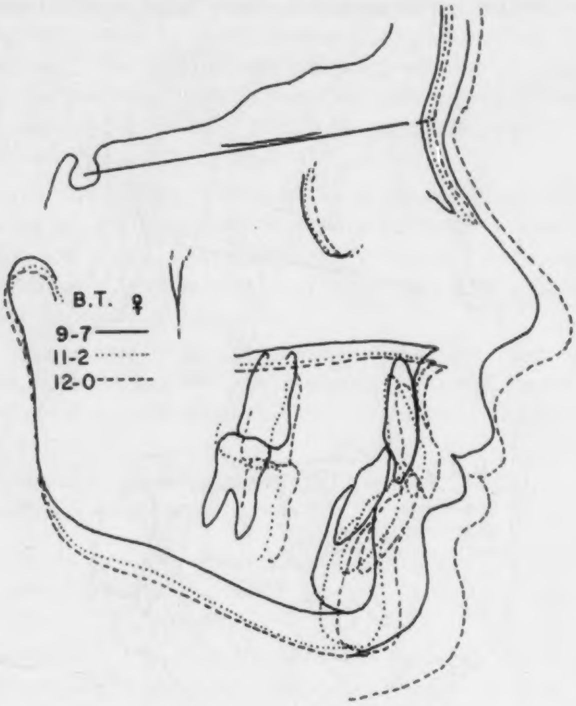


Fig. 26.

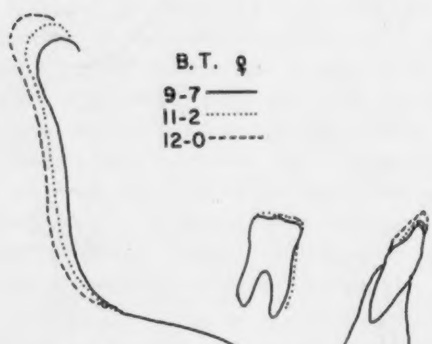


Fig. 27.

The over-all registration (Fig. 25) illustrates that this face grew in a predominantly vertical direction between the ages of 9 and 11 and in a horizontal direction between the ages of 11 and 12. The increase in nasal height occurred primarily between the ages of 9 and 11 years. Since there was little growth in the vertical plane of space between 11 and 12 years of age, then all growth that did occur during this period must express itself in an anteroposterior direction. This is evident when the over-all registration is studied. Nasion has moved forward but has maintained a stable vertical relationship to the cranial

base. The pterygomaxillary fissure also has maintained a relatively stable anteroposterior relationship to the cranial base during the growth period. The molar relationship has also changed from Class II to Class I.

The maxillary registration (Fig. 26) reveals that the maxillary incisors were carried forward while the maxillary molars were moved distally and erupted vertically between the ninth and eleventh years. During this time the premolars also erupted downward and backward. Between the eleventh and twelfth years the cervical anchorage had been discontinued. In this case, as well as in all the other treated cases previously reported in this article, a maxillary bite plane was used during a portion of the treatment. Between the ninth and eleventh years the maxilla did not increase in anteroposterior length, but between the ages of 11 and 12 it did increase. It is also interesting to note that the eruption that occurred between the ninth and eleventh years, in the molar region eventually resulted in depression of these teeth between the eleventh and twelfth years. The maxillary incisors were carried forward through the forces of occlusion from the lower incisors between the ninth and eleventh years and were carried further forward through growth of the maxilla between the eleventh and twelfth years. No appliance was used on the maxillary incisors.

The mandibular registration (Fig. 27) shows vertical eruption of the incisors, with a lesser amount in the molar region. Growth of the mandibular ramus in length as well as in height by growth of the condyle is also evident. The increments of mandibular growth are relatively equal between the stages studied.

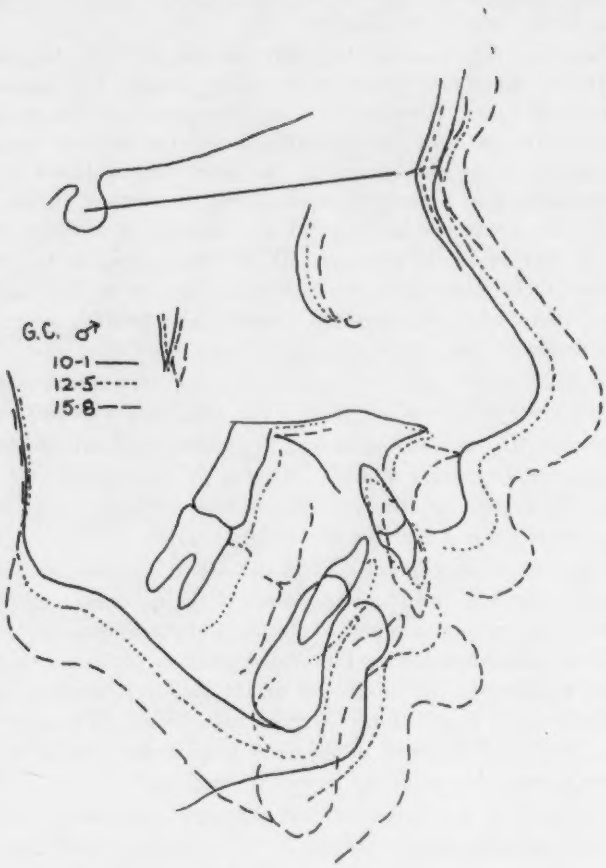
It has been often speculated that in the Class II, Division 2 malocclusion the mandible is in a retrusive position due to the position of the anterior teeth. Some have believed that when the maxillary incisors are moved forward the occlusion will become unlocked and the mandible will be allowed to assume its normal position. In this case it is evident that the maxillary incisors were moved by the growth of the mandible carrying them forward through the force of occlusion. A study of the over-all registration (Fig. 25) shows that the mandible has not been positioned forward in that the mandibular condyle is located more posteriorly in the last stage than it was in the initial tracing.

Again it has been demonstrated that the growth of the facial pattern can be favorably influenced through orthodontic therapy. A question should logically be asked at this point: Does orthodontic therapy always favorably influence the growth and development of the facial pattern? This question can best be answered by studying the next case to be presented.

Case 9.—Patient G. C. is a boy with a Class II Division 1 malocclusion. Growth between the ages of 10 years 1 month, 12 years 5 months, and 15 years 8 months is shown in Figs. 28, 29, and 30.

This patient was treated orthodontically, with cervical anchorage being applied to the maxillary first permanent molars between the ages of 10 and 12. Although there was some question as to the degree of cooperation being received during this period, the over-all registration (Fig. 28) illustrates that the molar relationship which had been Class II was changed to Class I at the 12-year level. At this time it was felt that the response to treatment had not been satisfactory, so a full-banded appliance for both the maxilla and the mandible was constructed and full treatment was initiated. This treatment was carried on until the patient was 14½ years of age, when it was decided that little progress had been made and that maxillary first premolars would have to be removed in order to retract the maxillary incisor teeth. Mandibular premolars were not removed, since the discrepancy in the anteroposterior plane of space between the maxillary and mandibular denture bases was so great that it was felt it would be virtually impossible to correct the malocclusion if the mandibular incisors were moved more lingually. At 15 years 8 months the patient was still under treatment but showed some progress. The patient had exhibited a tongue-thrust habit throughout the entire period of the study.

Fig. 28.



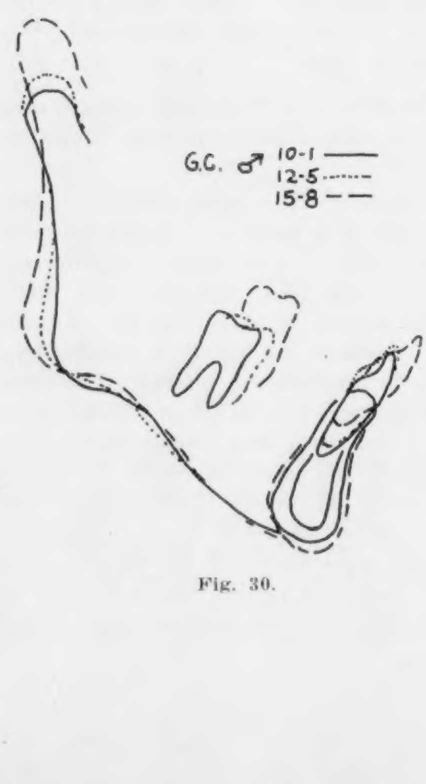


Fig. 29.

Fig. 30.

The over-all registration (Fig. 28) reveals a retrognathic type of face growing predominantly in a vertical direction, with the anterior portion of the maxilla showing a marked forward positioning in relationship to cranial registration. Nasion has moved forward and has maintained a relatively constant vertical relationship to the cranial base. The pterygomaxillary fissure has not remained in a constant anteroposterior relationship to the cranial base but has moved forward markedly. This, coupled with maxillary growth, has strikingly increased the functional length of the maxilla in relationship to the cranium.

The maxillary registration (Fig. 29) reveals little or no growth in length of the maxilla between the tenth and twelfth years, but between the twelfth and fifteenth years there has been a considerable increase in the length of the maxilla proper. Between the tenth and twelfth years the maxillary molar has erupted and moved forward slightly. The incisor was also carried forward a small amount during this stage. Between the twelfth and fifteenth years we note that the maxillary molar has moved forward markedly and has erupted downward, primarily because of the space gained by the extension of the first premolars. The maxillary incisor has also erupted vertically between the twelfth and fifteenth years.

The mandibular registration (Fig. 30) reveals a different growth pattern than we have previously observed in the cases reported here. Between the tenth and twelfth years there has been little eruption; however, between the twelfth and the fifteenth years there has been marked eruption of both the incisors and the molars. The mandibular condyle has grown predominantly in a vertical direction, with very little anteroposterior growth evident. The condylar angle in relation to the mandibular plane has become increasingly obtuse. It also may be noted that there is a marked antegonial notching of the lower border of the mandible which appears to have increased as the mandible developed. This antegonial notching is characteristic of persons who have suffered damage to the mandible condyle growth site. With the amount of growth that has occurred in the condylar region during the period studied, it does not seem possible that the notching is associated with arrested or deficient condylar growth. Definitely, however, the growth pattern of this mandible is markedly different from that which usually is observed.

This case is evidence that orthodontic therapy does not always favorably influence the developing facial pattern. The patient must have the genetic potential for favorable growth before the orthodontist can improve the interrelationship of the various bones that comprise the facial complex.

The cases presented were selected to illustrate some of the variations in growth of the facial pattern that exist in some of our patients. Conclusions reached after studying these records indicate that a distal or posterior force applied to the maxillary teeth may cause actual distal movement of the maxillary teeth. Also, such a force alters the horizontal growth pattern of the maxilla itself. Whether we call this "inhibition of growth," "arrested growth," or "altered growth" at this time is a matter of semantics. However, it is plain that under such force the profile length of the maxilla does not increase, or it increases a negligible amount. We must remember that this force is being applied against a suture where its effect is being transmitted to other cranial and facial growth sites. A similar force upon the mandible is upon a free-floating bone; therefore, in my opinion, it is not capable of "inhibiting" mandibular growth or, if in a reverse direction, of accelerating its growth.

A word should be said regarding the most opportune time for orthodontic therapy. In that growth has been shown to play an important role in the favorable alteration of the facial pattern of retrognathic persons, treatment time should correspond to periods of rapid growth. It is better to be too early than too late in starting treatment procedures that depend upon facial growth

for their maximum effect. Patience is a virtue in the orthodontist who recognizes the slowly developing child and is willing to time his treatment procedures accordingly. Too often dentures are prematurely mechanically traumatized because of the impatient orthodontist's desire to "see some action."

This is a preliminary report of a study which is under way, assessing the various growth patterns of a group of growing children with and without orthodontic therapy. The vast majority of previous studies have been on a statistical basis. It is felt that the major contributions from such studies have already been made. The next step is to study individuals, as has been done here, if we are to gain a true understanding of the variability that exists. A detailed study of individuals, assessing rates, amounts, and directions of growth, should lead to a completely new concept of the types of facial patterns and the dynamics of growth involved. The clinical implications of such knowledge are self-evident.

SUMMARY

In this article the following points have been emphasized:

1. A review was made of the major growth sites of the facial complex and their contributions to the development of varying types of facial patterns.
2. The methods of registration of serial cephalometric tracings, which have been previously used for the evaluation of individual facial growth patterns, were critically analyzed.
3. A new method of cranial registration was proposed and utilized in analyzing the facial growth patterns of growing children. Some of the children were undergoing orthodontic treatment; others were not.
4. The concept of the "constancy of the facial growth pattern" was questioned when applied to the individual. Ample evidence was presented to demonstrate that variation, not constancy, is the rule.
5. Two points—nasion and the pterygomaxillary fissure—previously thought to be relatively stable in all individuals, were proved to be highly variable during growth of some individuals.
6. Horizontal growth of the face is not necessarily more desirable than vertical development from the orthodontic point of view. The difference between favorable and unfavorable growth, from an orthodontic point of view, may perhaps best be explained in terms of individual bone morphology, bone interrelationship, and differential growth rates. These three phenomena are interdependent.
7. Orthodontic therapy will have a favorable influence upon the growth of the retrognathic type of facial profile, provided the genetic potential for harmonious development is present.

CONCLUSIONS

This study and the conclusions reached were not undertaken to support or deny any of the methods of orthodontic treatment currently in vogue. Rather, they serve to emphasize the basic factors of growth that are primary considerations with any type of orthodontic therapy.

The successful management of any orthodontic problem is dependent upon a proper balance between theory and performance. An understanding of the growth characteristics of the individual patient is essential to the most skillful treatment procedures if the ultimate clinical result is to be achieved.

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A CRITICAL ANALYSIS OF SERIAL EXTRACTION IN ORTHODONTIC TREATMENT

B. F. Dewel, D.D.S., Evanston, Ill.

Inadequate growth of supporting bone is responsible for the development of the procedure known as serial extraction. Its objective is to reconcile differences between a known amount of tooth material and a persistent deficiency in basal bone. It can and should be recognized in the early mixed dentition, and it finds its most effective application in severe Class I irregularities. The orthodontic responsibility is to differentiate between conditions that will respond to comprehensive treatment and those that should submit in the beginning to an extraction compromise.

Serial extraction is concerned with the limitations of both growth and treatment. Its purpose is to guide and control the eruption of teeth in arches that have no hope of attaining their maximum size and proportion. It is designed to anticipate and prevent the development of a fully matured deformity in the permanent dentition, and it is applied by the extraction, in the proper order, of a predetermined series of deciduous and permanent teeth.

By this procedure, serial extraction avoids one form of orthodontic negligence: Teeth in marked discrepancy cases are not first required to assume positions of extreme irregularity and then subjected to extensive orthodontic movement with extraction to establish acceptable occlusal relations. They are, instead, encouraged to take these positions in the first place.

The typical serial extraction case is a pronounced Class I malocclusion in its earliest stages of development. In its classic form, it presents any or all of a number of deviations from the normal. Among these are irregular anterior teeth, narrow arches, impacted or displaced lateral incisors, and marked reduction in arch length. Other indications are premature loss of one or more of the deciduous cuspids, various median line deviations, and a moderate increase in overbite and overjet. A further characteristic is that most of these patients present teeth that individually are sturdy and well proportioned; in addition, many of these cases seem to be relatively free from dental caries.

Loss of arch length is most apparent in the cuspid areas. Evidence of basal bone deficiency also is confirmed by a characteristically thin labial plate of alveolar bone in the lower incisor region; this may be so extensive as to

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cause gingival recession and alveolar destruction along the labial surfaces of one or both of the lower central incisors. Reduction of tooth mass usually results in an improvement in the gingival tissues.

The contrast with the normal is marked; normal mixed dentition cases that are maturing properly present evenly aligned teeth in well-developed arches. The opposite picture in the retarded serial extraction case is one of a general deficiency in structural development, with dental arches that have not been able to achieve their normal size and proportion.

Esthetics usually is not a problem in the early stages. In Class I patients, facial contours are still acceptable and the alignment of the teeth frequently shows no serious irregularity until the eruption of the permanent cuspids. Other cases may be bimaxillary protrusions with poor skeletal patterns and disturbed facial musculature. In these, the patients are as concerned with facial esthetics as they are with occlusal relations of the teeth. Still other cases are potential Class II malocclusions with, in the early stages, mild Class II facial contours.

The emphasis on active treatment differs between Class I and Class II serial extraction cases, even though a basic characteristic of each remains a marked discrepancy between total tooth material and potential supporting bone. Arch relations are acceptable in Class I irregularities; in these, serial extraction predominates in the early stages of treatment, with mechanical therapy occupying a secondary role at the conclusion of the preliminary period of supervision with extraction.

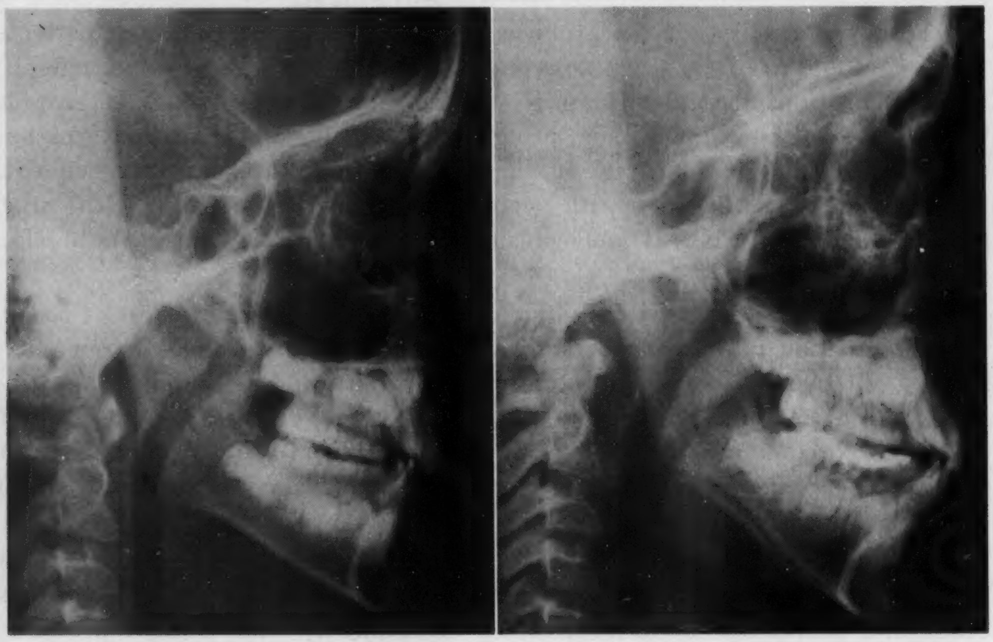
In contrast, the major emphasis in Class II treatment is mechanical in nature; these cases require early correction of anteroposterior arch relations. Therefore, severe Class II discrepancy irregularities are treated primarily with Class II mechanics, with serial extraction more or less as an accessory to mechanical therapy. Thus, in Class II malocclusion, appliances are placed early in treatment with the express intention of correcting the mesiodistal relations of the arches as promptly as possible.

From this, it can be seen that serial extraction may accompany Class II therapy and that active treatment and serial extraction are likely to be carried on simultaneously. In Class I, the extraction program almost invariably precedes active treatment. This, of course, is a general rule; many localized Class I irregularities also require early treatment. On the completion of these minor Class I corrections, serial extraction again takes precedence over active treatment during the eruption of the remaining permanent teeth. A possible exception is mechanical retention with an upper acrylic bite plate and a lower lingual holding arch during the intervening period of supervision. In a similar manner, active treatment is also interrupted in mild Class II discrepancy cases after normal arch relations have been established.

CLINICAL AND CEPHALOMETRIC ANALYSIS

Class I diagnosis depends in great part on an estimate of the potential arch length required to support a known amount of tooth structure. Among

Class I cases favored with sufficient supporting bone are certain cross-bites, open-bites, blocked-out premolars from premature loss of deciduous teeth, slight labial displacement of upper incisors from pressure habits, pseudo-Class III cases, and moderate crowding of anterior teeth. In all of these, the irregularity is localized; it is confined primarily to the teeth, with deeper supporting structures that are fully able to support any normal amount of tooth material.



A. *B.*

Fig. 1.—Cephalometric headfilms illustrate two extremes in structural development. *B* shows a pronounced "bimaxillary protrusion" with labially inclined incisors in a convex face. *A* illustrates the straight profile that is typical of the authentic Class I serial extraction case. In this film note the positions of the permanent cuspids, the reduction in arch length between first molars and lateral incisors, and the distance that the second molars must travel distally as well as occlusally in order to achieve full eruption.

Severe crowding of teeth does not fall in this category. This is particularly true of the lower incisors. At this point, the importance of the lower arch in case analysis and treatment planning should be stressed. If mandibuar development is seriously inadequate, no treatment measure seems to be effective in recovering an extensive loss in lower arch length. On the contrary, upper arch reduction irregularities usually respond to comprehensive treatment without extraction if mandibular development is normal. Class I patients with early loss of arch length in both arches are potential bimaxillary protrusion cases, especially if the arches are expanded in all directions to accommodate all the teeth. Any attempt to do so simply substitutes one form of malocclusion for another.

Cephalometrically, the typical Class I serial extraction case presents a facial pattern that can best be described as flat or straight (Fig. 1). This is in marked contrast to the opposite condition, which frequently is referred

to as double protrusion. In these, the incisors show a distinct anterior displacement when related to the facial plane, as represented by a line drawn from nasion to pogonion. The incisors are not only labially displaced but also have an increased labial inclination.

In bimaxillary protrusion cases the entire mass of teeth seems to occupy a wide area in the lower half of the face. In the classic serial extraction case this area is limited in extent; the incisors are more vertical and fall on or within the nasion-pogonion facial plane. The result is a reduction in arch length between the first molars and the lateral incisors, with total space loss that is approximately the width of a premolar in each of the four posterior segments of the dental arches.

It is apparent that the incisors in the serial extraction headfilm cannot be moved labially without displacing them beyond the supporting alveolar bone, particularly in the lower arch. Nor is it possible to gain the width of a premolar by distal movement of the molars. On their eruption, the second molars will require most of the space that further posterior development will provide; these second molars already must move distally as well as occlusally to reach the occlusal plane. When third molars are present, distal molar movement is virtually impossible in these discrepancy irregularities. The more practical treatment procedure in the authentic serial extraction case is the removal of selected premolars in the areas of greatest concentration and the repositioning of the remaining teeth in a normal alignment over the available basal bone. In this manner, a balance can be established between tooth material and supporting bone.

For these reasons, serial extraction seems to be the logical answer to the problem of inadequate structural growth mesial to the first permanent molars after their eruption and the eruption of the incisors. The conclusions of research investigators are (1) that growth of the anterior portions of the mandible and maxilla ceases for all practical purposes after the age of 6, or earlier, (2) that severe growth deficiencies cannot be recovered by orthodontic treatment, and (3) that effective simultaneous distal movement of upper and lower posterior teeth is an illusion. Expansion of teeth labially or buccally off apical base is not the answer, for expansion of the dental arch brings no assurance that the alveolar arch will, in turn, increase in width. Subsequent collapse with protrusion and crowding of incisors is seen far too often with these procedures. Clinically, extraction is not a radical solution in these extreme arch reduction irregularities; instead, it can be considered a conservative treatment measure if relapse and failure are to be avoided.

SERIAL EXTRACTION SEQUENCE

Preliminary interception and correction by serial extraction in authentic Class I discrepancy cases is accomplished, when indicated, in three separate stages for three specific purposes: (1) premature extraction of the deciduous cuspids provides space for the incisors to assume normal positions in an even alignment directly over basal bone, (2) subsequent extraction of the first

deciduous molars permits the desirable early eruption of the first premolars, and (3) the final extraction of the first premolars makes it possible for the cuspids to erupt in a favorable direction into the spaces formerly occupied by the first premolars. The interval between stages varies from six months to one year. There are occasional variations in this sequence, for each patient must be considered individually in serial extraction as well as in any other form of diagnosis.

Unfortunately, the cuspids and second premolars rarely assume ideal positions following the preliminary extraction stages, particularly in the lower arch. The resulting spaces and excessive inclinations of these teeth do not lead to permanence and stability. Comprehensive treatment, therefore, ultimately requires mechanical therapy for a relatively short period. In the majority of Class I patients, this is necessary only at the conclusion of the preliminary period of supervision with extraction. For this purpose, the edgewise mechanism provides the maximum efficiency in restoring these teeth to their normal inclinations and contacting relationships.

Serial extraction has a longer historical record than has generally been realized. The earliest attempt at guiding the eruption of permanent teeth by the extraction of deciduous teeth in retarded arches was made by a Frenchman, Robert Bunon,[5] in 1743. Hunter,[25] Fox,[19] Bourdet,[4] Harris,[20] and others also spoke of it but little else was written after the middle of the last century until Kjellgren[27] and Hotz[24] published their final conclusions in the late 1940's. Interestingly enough, the extraction sequence advocated by Bunon more than 200 years ago is virtually identical to that of today. Both the early efforts and current procedures have had the same goal—the removal of selected deciduous and permanent teeth in deficient arches so that the remaining unerupted teeth can assume acceptable positions in the adult dentition.

From this it may be seen that the extraction sequence in the typical serial extraction case has been fairly well established and accepted: first, the deciduous cuspids; later, the first deciduous molars; and, finally, the first premolars. As with any other procedure, there are exceptions to this order. The chief exception in serial extraction is in reversing the removal of the two deciduous teeth; in certain cases, the first deciduous molars are extracted before the deciduous cuspids.

The advantage is that the retained deciduous cuspids will delay permanent cuspid eruption while we are waiting for the desirable early eruption of the first premolars. The method is indicated when radiographic examination shows that the cuspids might erupt before the first premolars. When they do so in an underdeveloped arch, there is usually partial impaction of the first premolars. Since the lower cuspid frequently erupts before the first premolar, the relative positions of these specific teeth must be determined before any extractions are undertaken.

With this extraction sequence, several conditions must exist in any given arch. Both deciduous cuspids must be present, arch length measurements

should be unfavorable, and none of the incisors should be completely impacted. The second deciduous molars must be sturdy enough to remain in position for several years, and there should be no gingival recession or alveolar destruction along the labial surfaces of the lower incisors.

If these conditions are met, the orthodontist will find that he is dealing with a borderline case. He is not yet sure whether extraction is even indicated, and he will not want to take any action that is irrevocable. His first step is to take all the usual records and then place the patient under observation to determine whether future development is favorable.

If it is, he can place the patient under full treatment without extraction. If it is not, he will not be jeopardizing any possible further development by the extraction of the first deciduous molars. The sturdy second deciduous molars can be depended on to prevent mesial movement of first permanent molars and the deciduous cuspids are quite effective in preventing lingual displacement of the incisors. If the timing is correct, the first premolars will be far enough along to erupt in an orderly manner. Meanwhile, retaining appliances can be placed to maintain arch length if natural retention appears to be questionable.

Up to this point, no action has been taken that is irretrievable. If growth unexpectedly takes a favorable turn, comprehensive treatment with a full complement of teeth can still be undertaken. If growth continues to be inadequate, ample time remains to proceed with the rest of the serial extraction program involving the deciduous cuspids and first premolars. With this method, active treatment also is delayed until the eruption of the permanent cuspids.

THE DIAGNOSTIC IMPORTANCE OF THE DECIDUOUS CUSPIDS

One of the principal clinical symptoms of an authentic Class I serial extraction case is premature loss of the deciduous cuspids. This occurs so frequently that it must have diagnostic significance. Its common association with deficient arches leads to one of two conclusions: either early loss of the cuspids is the cause of the reduction in arch length or, more likely, inadequate development is the cause of early cuspid loss (Fig. 14).

The deciduous cuspids are fully able to maintain their positions in well-developed arches; in these, premature resorption of the cuspid roots rarely occurs. In retarded arches, the crowns of the unerupted permanent lateral incisors are virtually in contact with the roots of the deciduous cuspids. These teeth normally are located in a congested area at the corner of the arch. If sufficiently restricted in developmental space, the eruptive force of the lateral incisors is quite capable of causing extensive resorption of both of the cuspid roots. In cases of unilateral cuspid loss, the remaining cuspid usually shows evidence of partial root resorption from earlier lateral incisor crown invasion. On the subsequent loss of the deciduous cuspid, the lateral incisor erupts into the space formerly occupied by the cuspid crown.

Occasionally, the developing lateral incisors are so located that during eruption they are deflected far to the lingual side of the central incisors and

deciduous cuspids. When this occurs, the cuspids retain their positions, but arch length is so reduced that only a few millimeters remain for the lateral incisors between the central incisors and the deciduous cuspids (Fig. 5).

More often, only one deciduous cuspid is lost prematurely in an underdeveloped arch; the remaining cuspid is able to retain its position only because all four incisors have shifted toward the space on the opposite side. For example, on the loss of a lower right deciduous cuspid, the four incisors will move to the right into the recently vacated cuspid space (Fig. 14). Thus, right cuspid space closure is due to a lateral displacement of the anterior teeth; it is not the result of a mesial migration of the posterior teeth. As far as the molars are concerned, they more often retain rather stable positions on either side of a balanced arch, an arch that basically is symmetrical even though deficient anteroposteriorly. Any lack of symmetry is due to a lateral displacement of the median line.

When this occurs in extremely inadequate arches, the lateral incisor may even establish contacting relations with the first deciduous molar. Usually, a space of 1 or 2 mm. remains between these teeth; this, obviously, is much less than the permanent cuspid requires. If deciduous cuspid loss is bimaxillary and accompanied by other symptoms of retarded development, clinical evidence is conclusive that serial extraction is indicated if posttreatment relapse and failure are to be avoided.

When one deciduous cuspid retains its position in an underdeveloped arch, usually all the teeth on that side maintain secure contacting relations. The resulting median line deviation now takes on diagnostic importance; repositioning the incisors back to center can be accomplished only by extraction of the remaining cuspid or by moving all the posterior teeth distally on that side. Distal movement would be difficult, if not impossible. Extraction is the more advisable procedure; it permits the incisors to shift back to center. This increases cuspid space on the one side and decreases it on the other, but both sides remain deficient in permanent cuspid space. None of this solves the actual cause of the irregularity—an arch that has failed in anteroposterior development. If this is to be corrected, other means must be sought. At present, no method has been devised to increase arch length that basically is lacking in structural development.

Ultimately, these serial extraction cases require active orthodontic treatment to close the remaining spaces and to correct the excessive inclinations of teeth on either side of the extraction areas. For this reason, the responsibility for any extraction program must be assumed by the orthodontist; only he has had enough experience in correcting deceptive borderline nonextraction cases to know which will respond to comprehensive treatment without extraction and which may require this compromise measure. Serial extraction diagnosis demands a fine sense of clinical judgment, backed by long and critical study of the possibilities as well as the limitations of growth and development. These are the cases that require the most exacting analysis; yet

the diagnostic evidence is often uncertain and sometimes actually unreliable. The extraction of teeth is not to be taken lightly; the ability to discriminate between borderline corrections in orthodontics is of the utmost importance if diagnostic errors are to be avoided. It would be tragic if even one patient had to submit to four dental bridges to compensate for a miscalculation in a nonextraction case. Much of this article stresses caution to orthodontists against indiscriminate extraction. If the orthodontist needs to be concerned about its dangers, certainly no one untrained in orthodontics will want any part of it.

CASE REPORTS ON SERIAL EXTRACTION TREATMENT

The first serial extraction case report illustrates a typical Class I malocclusion resulting from inadequate supporting bone (Fig. 2). The arches are narrow and space for the lateral incisors is so reduced that these teeth are either unerupted or displaced labially or lingually. Radiographic examination also disclosed large cuspids and first premolars, with no favorable leeway space for the normal mesial repositioning of the first permanent molars on the loss of the second deciduous molars.

Three alternatives are available to the orthodontist in the treatment of this patient. Obviously, a complicated malocclusion is in its earliest stages of development. One alternative, of course, is to embark at once on a prolonged period of active treatment in an attempt to create enough space for all the permanent teeth. Relapse, followed by a second period of treatment and belated acceptance of an extraction compromise, would be the probable result.

Another alternative is to postpone treatment until all the permanent teeth have erupted in whatever positions they are able to take in these deficient arches and then determine what method of treatment is most advisable. It seems irrational, however, to require the developing permanent teeth to erupt into positions of extreme malocclusion and then move them relatively long distances to establish reasonably normal occlusal relations.

The third alternative, and the one chosen for this case, was to follow a program of serial extraction on the conviction that ideal development of the supporting structures could not be achieved by mechanical means. As a result, all four deciduous cuspids were extracted. This ordinarily is the first step in the serial extraction sequence; its purpose is to permit the incisors to assume normal positions in an even alignment directly over the supporting alveolar bone.

Preliminary treatment was also undertaken to correct a developing Class II tendency. After this had been accomplished, the appliances were removed and a lower lingual wire retainer was placed to maintain arch length while waiting for the eruption of the permanent cuspids and second premolars. Myofunctional exercises were also given to lengthen the upper lip and to reduce the activity of a hypertonic mentalis muscle (Fig. 4).

The next set of plaster casts was secured after the subsequent extraction of the first deciduous molars (Fig. 2). This is the second step in the usual serial extraction program; its objective is to permit the early eruption of the first premolars so that the permanent cuspids will not be displaced labially in a deficient arch. After these casts had been secured, the four first premolars were extracted, thus completing the third and final step in the serial extraction procedure. Their removal made it possible for the cuspids to erupt in a distal direction into the spaces formerly occupied by the first premolars.

The third set of plaster casts illustrates the positions that the cuspids assumed of their own accord on their final eruption into the dental arch. If

A.

B.

C.

D.

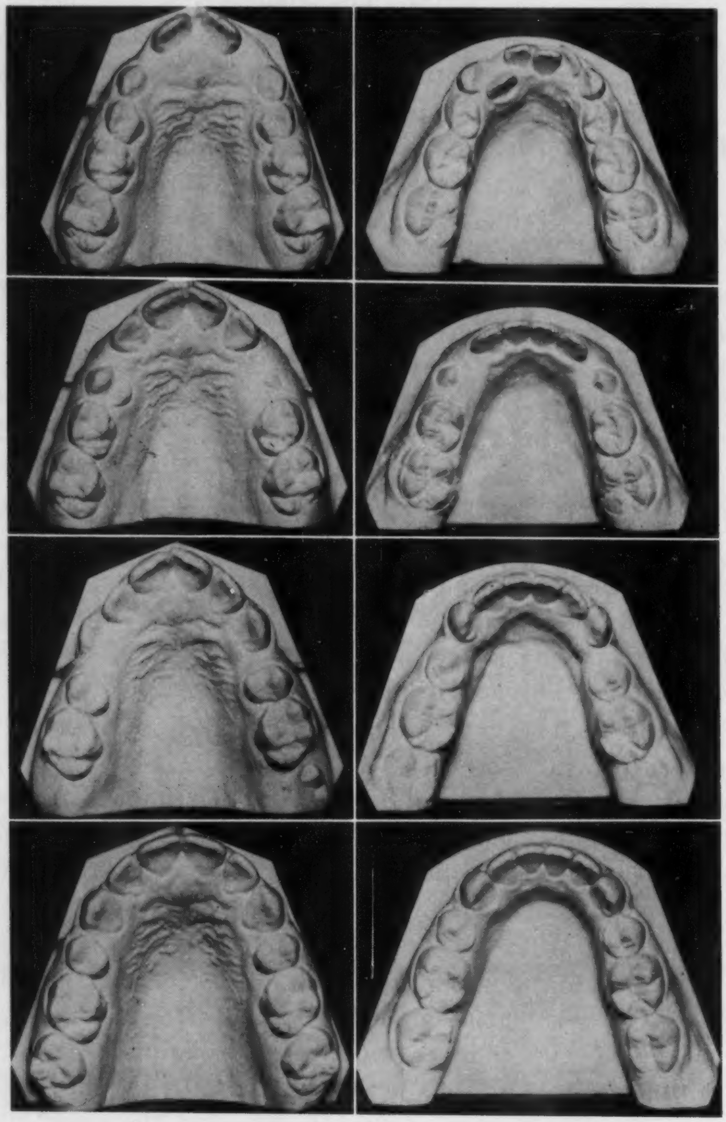
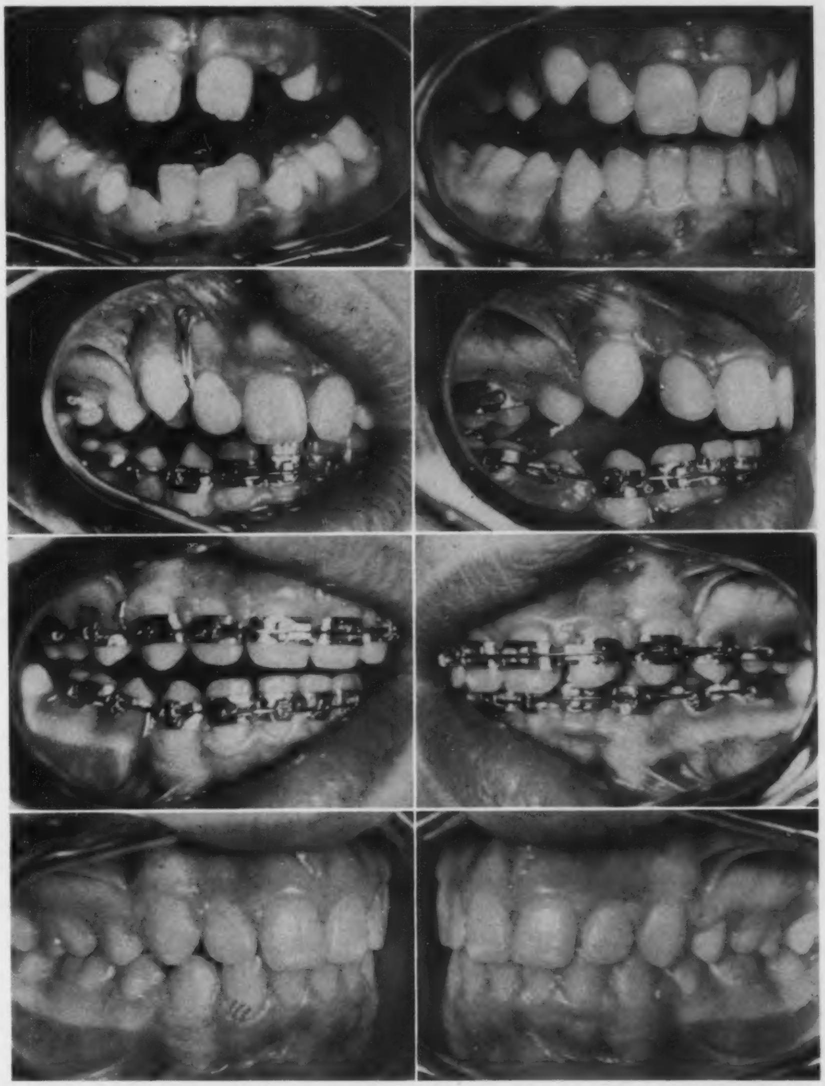


Fig. 2.—Plaster casts of an authentic serial extraction case during the preliminary period of supervision with extraction. *A*, The original malocclusion prior to the extraction of the deciduous cuspids and later of the first deciduous molars. *B*, Casts taken before the extraction of the four first premolars. *C*, Cas's secured when active treatment was started. *D*, The final correction three years after the removal of retention. Compare with Fig. 3.

space had not been provided by a preliminary program of serial extraction, these cuspids would have erupted in positions of extreme labioversion. The incisors remain well located over apical base, and the molars have retained normal mesiodistal cusp relations (Fig. 3).



A.

B.

C.

D.

Fig. 3.—Intraoral photographs of the serial extraction case shown in Figs. 2 and 4. In *A*, the original malocclusion is shown on the left and the improvement in tooth position during the preliminary stages of supervision with extraction is shown in the right. *B*, A maxillary acrylic plate utilizing tissue-borne anchorage for distal cuspid movement. *C*, The edgewise appliance used to close the extraction spaces and to correct the rotations and inclinations of individual teeth. Intermaxillary hooks are for vertical elastics to correct a persistent tongue-thrusting habit in the right cuspid area. D, The correction three years following removal of all retention.

A major limitation in these patients is the failure of the mandible to achieve its maximum growth, particularly in the lower incisor area. Although growth in the anterior portion of the maxilla also appears to stop after the eruption of the first permanent molars, similar irregularities in this arch do not seem to be as complicated or as difficult to treat as in the lower arch. Loss of upper arch length in these cases appears to be due to a mesial

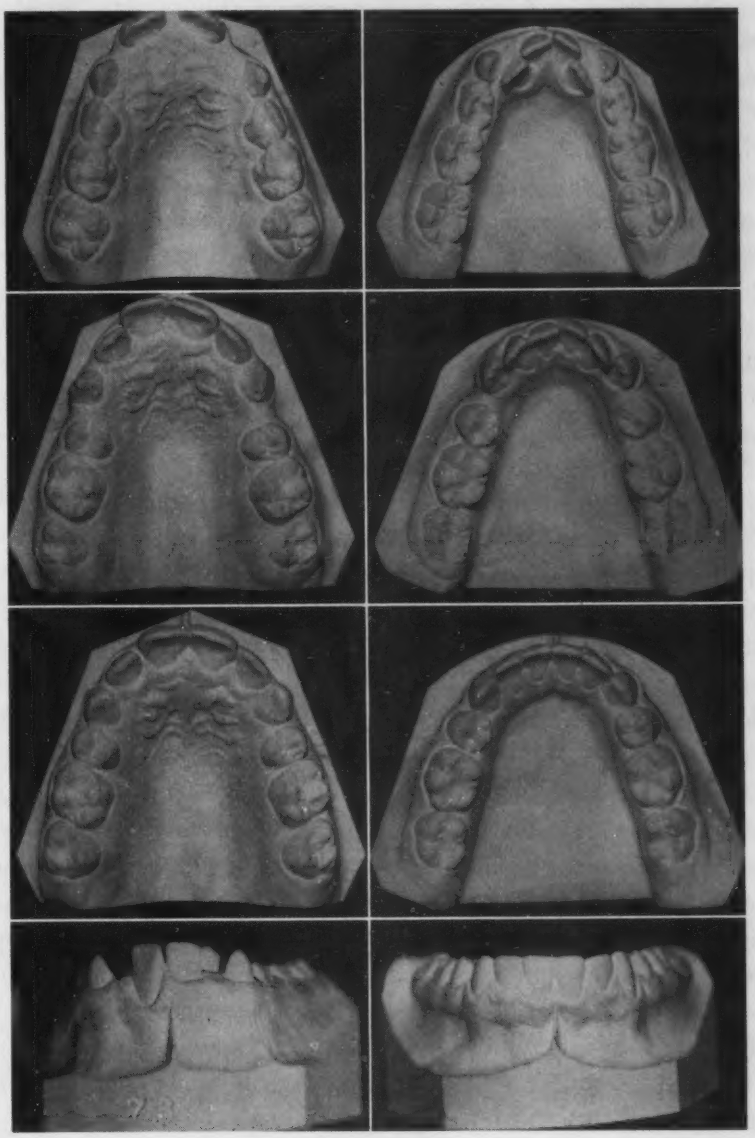
migration of posterior teeth; severe mandibular crowding is more likely the result of deficient supporting structures. Thus, when the lower arch is normal, upper posterior teeth usually can be moved distally without extraction. Consequently, bimaxillary extraction is almost always an essential part of treatment when lower arch development is seriously inadequate, and it is rarely to be considered when the irregularity exists only in the upper arch.

Fig. 4.—Original and final photographs of patient treated with a preliminary period of supervision with serial extraction. Plaster casts and intraoral photographs are illustrated in Figs. 2 and 3.

Our responsibility lies as much in recognizing incipient malocclusion as it does in correcting fully developed deformities in the permanent dentition. In this patient the extractions were completed early enough that the remaining teeth could migrate into favorable positions during the supervisory period. Major orthodontic treatment was not undertaken until the eruption of all the permanent teeth; its purpose was to close the remaining spaces and to correct the inclinations of the teeth on either side of the extraction spaces (Fig. 3). An edgewise appliance was placed at once on the lower teeth. In order to protect maxillary anchorage, an acrylic plate with wire springs was inserted to move the cuspids distally before placing the upper edgewise appliance. Intraoral photographs illustrate the complete appliance in the last stages of active treatment. The final casts, facial photographs, and intraoral views were secured three years following the removal of all retention.

ARCH LENGTH REDUCTION AND GINGIVAL RECESSION

The next case illustrates a more extreme deviation in lower lateral incisor eruption (Fig. 5). It is not difficult to predict that in the adult dentition these lower teeth will remain locked lingually to the permanent cuspids.



A.

B.

C.

D.

Fig. 5.—Borderline irregularity treated with a preliminary program of serial extraction. The decision to extract was based principally on the gingival recession and alveolar destruction along the anterior surface of the labially displaced lower right central incisor. *A*, The original condition. *B*, The improvement following serial extraction and before active treatment with the edgewise appliance. *C*, The correction two years following removal of all retention. Compare with Figs. 6 and 7.

Occasionally, the developing buds of the lateral incisors are so located that, as they erupt, they are deflected far to the lingual of their normal positions in the dental arch. When this occurs, the deciduous cuspids are fully able

to maintain their positions until the normal time for their loss. Nevertheless, it remains an authentic serial extraction irregularity, and the orthodontist must rely on other symptoms to confirm his clinical judgment.

The lower arch presents the greater problem in the correction of this Class I malocclusion. The upper arch is not as narrow as in the previous case; it would yield enough to general expansion to provide space for the unerupted lateral incisors. If conditions had been as favorable in the lower arch, there would have been no necessity to consider extraction in the correction of this irregularity.

This case emphasizes the importance of the lower arch in clinical diagnosis and treatment planning. This conclusion is based on two factors—adequate arch length and a stable position of the lower incisors over basal bone. When these are normal, mandibular development is acceptable and treatment can proceed with a full complement of teeth. Thus, if a given procedure can be accomplished without extraction in the lower arch, it ordinarily can be accomplished without extraction in the upper arch, with the usual exceptions that accompany such a comprehensive rule as that.

Our challenge lies in the lower arch in general and in the lower incisors in particular. These incisors must be maintained or established over apical base if collapse is to be avoided; yet, they are both the least stable and the most easily moved of all teeth, upper or lower. In contrast, the lower molars at the opposite end of the arch are the most rugged and the most difficult to move of all teeth. Caught in between are late-erupting cuspids and premolars that demand their place in the dental arch. With the weakest of all teeth in front and the sturdiest of all teeth in back, there can be but little question that the lower arch presents the greater challenge in the treatment of orthodontic irregularities.

Thus, correction in the lower arch can best be attained by repositioning the six anterior teeth over apical base and then permitting the lower molars to move forward into the remaining extraction spaces. This statement must be qualified: deliberate mesial movement of molars should not be undertaken in the early stages of active treatment. The tendency of all posterior teeth is to move mesially, and the problem ordinarily is to keep them from doing so. If molars are moved distally beyond their normal positions, they only too readily will move forward on their release from mechanical restraint. On the contrary, no molar will move distally of its own accord after it has once been displaced in a mesial direction.

A major concern in this patient was the gingival recession and alveolar destruction along the labial surface of the lower right central incisor. Occasionally the frenum is the cause of these gingival conditions, but distention of the lower lip gave no evidence that it was involved in this case. This central incisor did not deliberately move beyond the alveolar supporting bone; it was forced into this position in an arch that was too small to accommodate all the teeth in an even alignment (Fig. 5).

In this case, the required space could not be secured by general expansion, including labial movement of the lower incisors. Distal movement of posterior teeth also was impractical, if not impossible; intraoral roentgenograms showed sturdy cuspids and first premolars, and supplemental lateral roentgenograms disclosed signs of probable crowding and impaction in the lower second and third molar areas. Thus, the problem increases. Even if it were possible by orthodontic means to create additional growth in these posterior regions, simultaneous distal movement of all the upper and lower molars would be difficult with our present mechanical aids. Increased impaction would be the more likely result.

For these reasons, the most conservative course was the removal of certain intervening teeth between the anterior and posterior segments of the dental arches and the repositioning of the remaining teeth in a normal alignment over apical base. As a result, a balance could be established between excessive tooth material and insufficient supporting bone.

It was this reasoning that led to preliminary supervision with serial extraction, but it was conducted in a cautious and deliberate manner. Although growth is uncertain and unpredictable, no orthodontist can be sure that it will be unfavorable. Yet, the lower right central incisor in this case demanded immediate relief. Therefore, the deciduous cuspids were extracted to permit an improvement in the positions of the four incisors. To assist in attaining this objective, a lower lingual arch wire was placed; it was also designed to prevent a further loss in arch length during the subsequent period of supervision.

In this patient there was no increase in structural development during the following twelve months. The four first deciduous molars were then extracted, and the first premolars were removed as they erupted (Fig. 5). The edgewise appliance was not placed until the subsequent eruption of the cuspids and second premolars. In this manner, active treatment can be reduced to a matter of months at the conclusion of an orderly program of serial extraction.

Final results are illustrated in occlusal views of the plaster casts and in intraoral photographs secured two years after the removal of all retention (Fig. 6). The principal area of failure is the lack of secure contacting relations on both sides of the upper lateral incisors; this was the result of a discrepancy between the combined mesiodistal widths of the upper and lower teeth. Improvement in the gingival tissues on the labial surface of the lower central incisors is more satisfactory.

Intraoral roentgenograms illustrate reasonably vertical positions of the teeth on either side of the first premolar extraction areas (Fig. 7). This was due in great part to proper timing in the serial extraction sequence. Further photographs illustrate facial contours two years following the removal of retention. The profile view, in particular, shows no external evidence that four teeth had been removed in the correction of this irregularity.

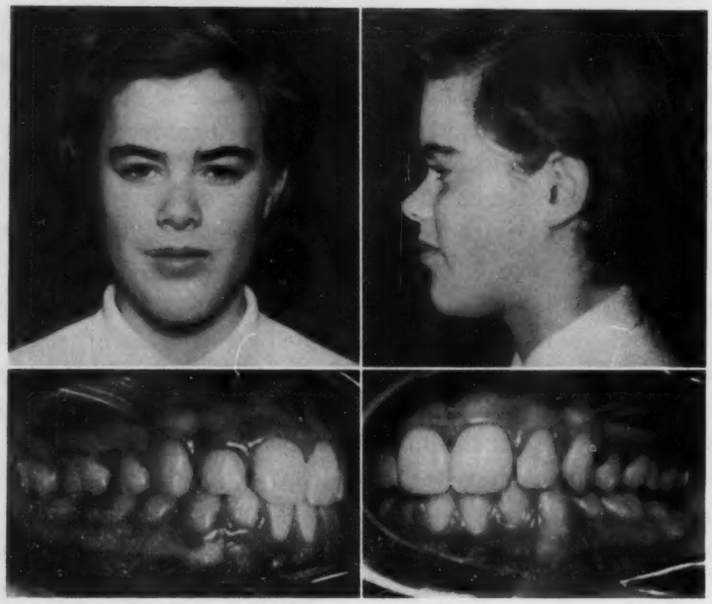


Fig. 6.—Facial photographs and final correction of borderline case shown in Fig. 5. The profile photograph shows no evidence that four first premolars had been removed in the treatment of this case. Marked improvement in the gingival tissues in the lower incisor region is apparent in the intraoral photographs secured two years after the removal of all retention.

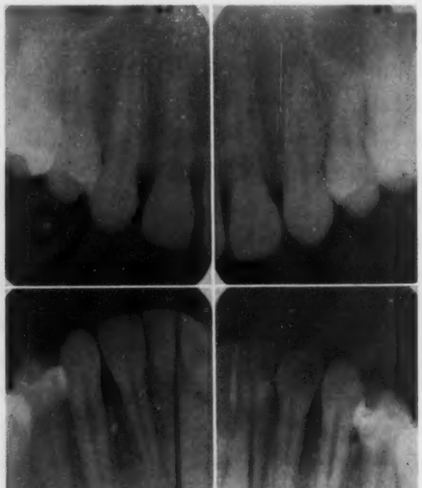


Fig. 7.—Intraoral roentgenograms of patient shown in Figs. 5 and 6 illustrate reasonably parallel roots on either side of the first premolar extraction areas. This was due in great part to proper timing in the serial extraction sequence and also to the secure bracket control of the edgewise appliance in rotating and uprighting individual teeth.

DELIBERATE CAUTION IN SERIAL EXTRACTION

The next early authentic serial extraction case is an example of cautious preliminary supervision (Fig. 8). This patient was first observed in 1943, sixteen years ago, and treatment deviates from current procedures in only one detail. The patient's father was a pediatrician who had had excellent training in growth and development; consequently, he was entitled to serious

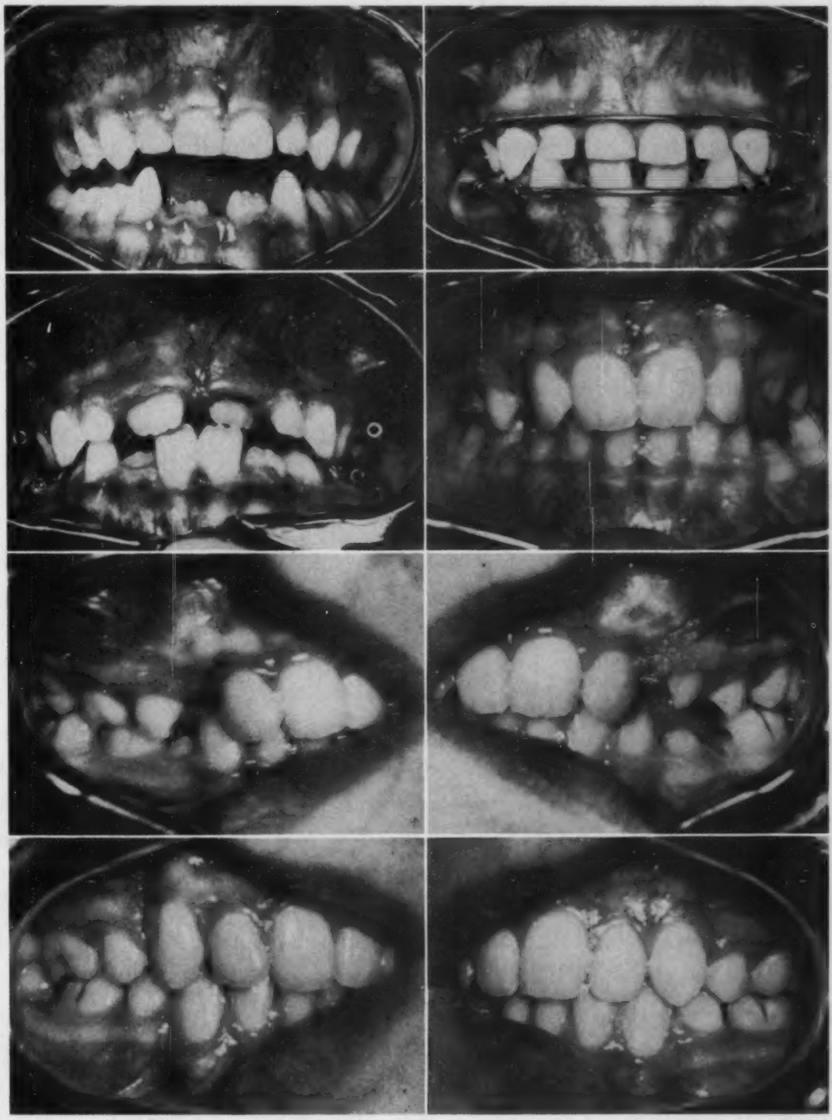


Fig. 8.—Preliminary treatment with expansion was first attempted at the request of the patient's father, a pediatrician, for reasons given in the text. Developmental failure is shown by premature loss of the lower left deciduous cuspid, the thin labial plate of alveolar bone in the lower incisor region, and the lingually erupting upper left central incisor. The lower center photographs were secured after serial extraction of the deciduous cuspids and first deciduous molars and prior to the extraction of the first premolars. The bottom photographs show final results thirteen years after the top left illustration and seven years after treatment had been concluded.

consideration of his own diagnostic conclusions. Following an entirely satisfactory consultation, he made the reasonable request that an attempt be made at expansion before an extraction program was undertaken.

This was at the time when I had just completed my concept of the serial extraction sequence. Therefore, I was not able to demonstrate a sufficient number of these cases several years following treatment to show results that were undeniably valid. Failure in the expansion program during thirteen months of active treatment was as convincing to him as to me.

Marked reduction in lower lateral incisor space is apparent in the original intraoral photograph. There was, of course, no urgency at such an early age for starting a program of serial extraction. Therefore, I was not too reluctant to attempt corrective measures since, unaccountably, some of these cases do respond to ideal treatment. It is when they do not respond that the orthodontist must be prepared to reverse treatment methods and resort to serial extraction.

Two photographs illustrate the result of the expansion procedure (Fig. 8). Sufficient space had been obtained across the maxillary arch for the eruption of the lateral incisors, but this had been accomplished only by tipping the deciduous cuspids somewhat beyond the underlying basal bone. The upper left central incisor provided further evidence of unsatisfactory anteroposterior growth by erupting to the lingual of the lower incisors. Of greater diagnostic importance was the premature loss of the lower left deciduous cuspid, the position of the lower left lateral incisor in the cuspid space, and the continuing discrepancy between tooth material and supporting bone.

Orthodontists are now aware of the developmental limitations imposed by basal bone in the lower incisor area. These same limitations also exist in the cuspid and premolar regions; overexpansion of posterior segments will result in collapse, just as it does when the anterior teeth are moved labially beyond the alveolar supporting bone.

This leaves distal movement of the posterior teeth as the only remaining possibility. This could be accomplished easily if first molars were the only teeth involved. It is certainly contraindicated, however, when they are backed up by large second molars located below the distogingival curvature of the first molars and by third molars that show evidence of impaction even at this early age. These are the cases in which arch length deficiencies demand an exact analysis. Extraction all too frequently must be considered if teeth are to be established in pleasing and permanent positions.

The appliances that had been placed on the deciduous teeth were therefore removed and serial extraction procedures were begun, with the immediate extraction of the upper deciduous lateral incisors and the three remaining deciduous cuspids. The patient was placed under supervision, and at the proper time the four first deciduous molars were removed.

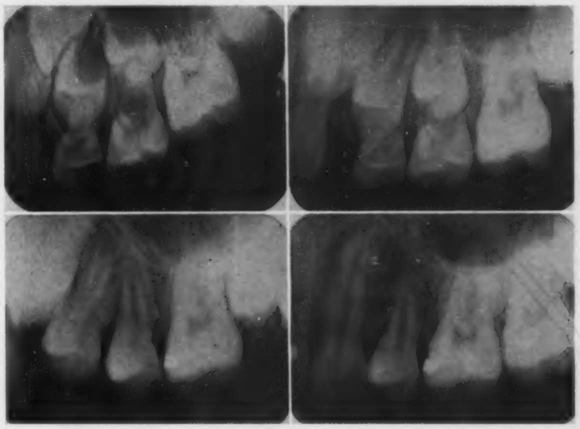
Two illustrations show occlusal relations three years later (Fig. 8). Development had been reasonably acceptable, but arch length still was too short to accommodate all the permanent teeth. Therefore, the four first premolars were extracted and supervision was continued until the second deciduous

molars had been lost by natural means and the cuspids and second premolars had erupted. The edgewise appliance was then placed to close the spaces and complete the correction. The final intraoral photographs illustrate occlusal relations five years after the removal of all retention.

Fig. 9 demonstrates the usual serial extraction sequence roentgenographically. *A* illustrates the crowded positions of the permanent teeth in 1943 before the extraction of the deciduous cuspid. In this view the unerupted lateral incisor is directly above the deciduous cuspid and virtually in contact with the first premolar. Space for the permanent cuspid appears to be nonexistent.

Fig. 9, *B* taken two years later, shows well-proportioned premolars, insufficient arch length, a partly blocked-out cuspid, and a second molar in contact with the root of the first molar. The first deciduous molar was removed at this time.

A. *B.*



C. *D.*

Fig. 9.—Four intraoral films illustrate roentgenographically the usual serial extraction sequence. The film in *A* was secured in 1943 before the extraction of the deciduous cuspid. *B* was taken before the removal of the first deciduous molar, and *C* was secured before the extraction of the first premolar. *D* was taken thirteen years after *A*. Intraoral and facial photographs of this patient are shown in Figs. 8 and 10.

The roentgenogram in Fig. 9, *C* was taken just before the extraction of the first premolar. Note the mesial inclination of the cuspid; on the extraction of the first premolar, the cuspid crown will migrate distally until ultimately the entire tooth assumes a normal vertical position. In this roentgenogram observe also the distance which the second molar must travel distally as well as occlusally to reach the occlusal plane. If the cuspid space is to be opened without extraction, the first molar would have to be moved distally. This would lead, in all probability, to a buccal displacement of the second molar and to impaction of the third molar.

Fig. 9, *D* illustrates the final correction five years after removal of all retention and thirteen years after the original roentgenogram in Fig. 9, *A*. Teeth are reasonably vertical, roots are parallel, the second molar has a normal inclination, and there is ample space distal to the second molar for the

eruption of the third molar. This is a case in which orthodontic correction was indicated. A cautious program of serial extraction provided the means to do it in an efficient manner.

Serial extraction is as concerned with facial appearance as it is with occlusal relations of the teeth. The original photographs were taken at the time of the first examination in 1943 (Fig. 10). They form an important part of every case analysis. These early photographs show relaxed and passive musculature which should not be disturbed by labial movement of anterior teeth. The profile view approaches the ideal in facial balance and proportion in the preadolescent child. The goal of the orthodontist should be to preserve this symmetry and harmony, not to destroy it.

Fig. 10.—Original photographs of case shown in Fig. 8 illustrate facial contours when the patient was first examined. Final photographs secured thirteen years after preliminary supervision with serial extraction and subsequent treatment with the edgewise appliance show good facial balance and proportion in relation to other cranial structures.

Patients, of course, are more than casually interested in occlusal function. They also may justifiably regard what they look like to be of equal importance to their future happiness and welfare. We must not compromise with our ideals in restoring normal function; yet facial esthetics should be granted an equally important role in every case analysis. This does not mean that we should strive for a standardized concept in facial form, for patients must be permitted to retain their individual character and identity in facial appearance. The extent to which this was achieved is illustrated in photographs secured thirteen years after the first examination. They show virtually no change in facial contours from that when serial extraction was first undertaken.

CLINICAL ANALYSIS IN THE DECEPTIVE NONEXTRACTION CASE

No one who writes about broad areas of extraction in orthodontics should do so without showing at least one case which might superficially appear to fall in that category but which, instead, should be treated in a conventional manner with a full complement of teeth. Growth is an obscure and unpredictable quality, and certain normally developing mixed dentition cases actually pass through stages in which potential malocclusion seems inevitable. Still others need only a little guidance to develop a pleasing appearance and normal occlusal relations.

There is no place for indiscriminate extraction in orthodontics; the ability to conduct a thorough differential diagnosis is a distinguishing characteristic of competence in every profession. The subject of this article is

A.

B.

C.

Fig. 11.—Facial photographs of nonextraction patient shown in Figs. 12 and 13. The photographs in *A* were taken when treatment was started. The photographs in *B* were secured on the termination of active treatment, and the photographs in *C* were taken five years following removal of retention.

serial extraction, and it therefore should properly receive the greater emphasis. Yet, at least one similar nonextraction case should be shown to discredit any thoughts that espousal of serial extraction implies advocating a policy of extraction with abandon in every Class I mixed dentition irregularity. The case to be shown next is typical of those deceptive nonextraction cases that could be and are being subjected erroneously to a program of serial extraction on the mistaken assumption that they fall in that category.

Study of the face is as essential as that of the teeth. This patient presents skeletal structures that are adequate and facial musculature that is passive and relaxed when the lips are closed (Fig. 11). The original profile photograph shows lips that are full but not unduly prominent. It illustrates facial contours that need not be disturbed if sufficient space can be secured for all the teeth without displacing the incisors labially beyond the limits of the supporting bone.

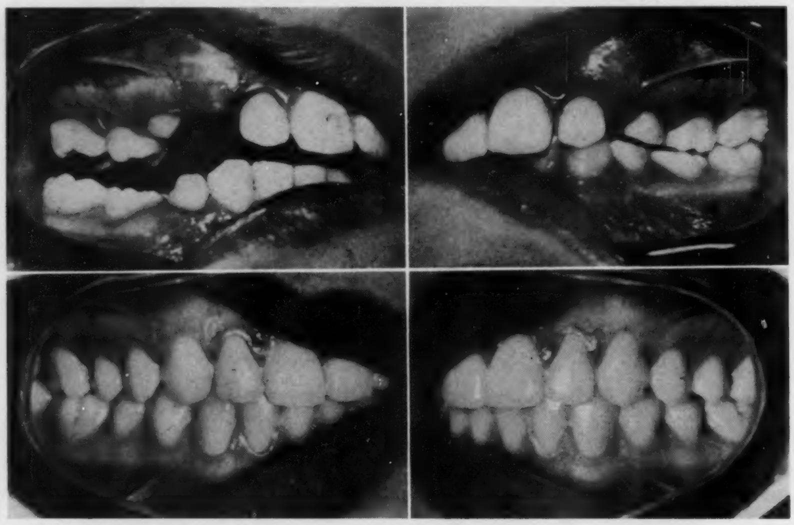


Fig. 12.—Intraoral views of nonextraction case shown in Figs. 11 and 13. Superficially, this irregularity appears to call for a program of serial extraction prior to active treatment. The lower photographs illustrate occlusal relations five years after removal of all retention.

The left intraoral photograph shows premature loss of the upper left deciduous cuspid and marked reduction in permanent cuspid space, but this is not difficult to recover when mandibular growth is normal (Fig. 12). The right intraoral photograph is of greater diagnostic significance. Premature loss of the lower first deciduous molar permitted the posterior teeth to tip mesially, the cuspid to tip distally, and the median line to shift to the right. The upper posterior teeth have also moved mesially; this can be determined by the loss in anteroposterior arch length and by the mesiolingual rotation of the first permanent molars. This is a characteristic change in the position of the upper molar when it drifts forward.

These variations are not due to inadequate skeletal structures. They are, instead, typical changes in the position of permanent teeth resulting from the

premature loss of deciduous teeth in arches that are fully developed. Since they lack the all-important support of continuous contacting relations, the remaining teeth simply drift through the adequate alveolar bone, and as they drift they tip and rotate (Fig. 13).

It may seem strange, but lower molars do not usually show as great a degree of tipping in cases with deficient basal bone as they do when the supporting structures are normal. It is only when a lower molar drifts mesially that it tips; it does not do so when its anteroposterior position remains stable. Figs. 14 and 15 illustrate upright lower molars in an underdeveloped arch. When arch length is inadequate, the lower first permanent molar erupts vertically from a deficient base. Its crypt is forward to begin with; it has not started out in one position in the anteroposterior plane and ended up in another; it has moved vertically, not horizontally, from its point of origin. In retarded arches, the space for it to tip forward simply does not exist; too many deciduous and permanent teeth already are congested in a reduced area in front of the tooth. In well-developed arches, however, sufficient space is present for teeth to move around freely and, as they do, tipping is more apparent just as it is in the nonextraction case now being considered (Fig. 12).

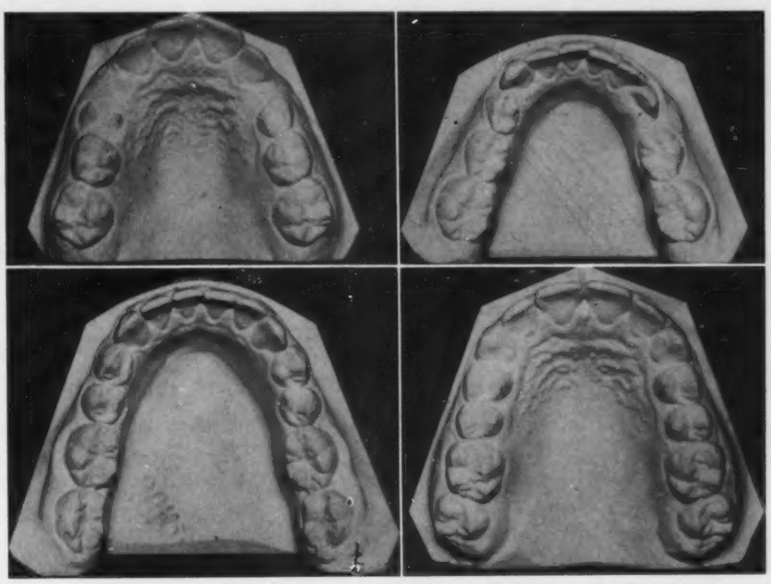


Fig. 13.—Deceptive borderline case which superficially gives the appearance of a serial extraction irregularity. See text for a detailed discussion on differential diagnosis between extraction and nonextraction cases. The lower photographs illustrate the correction with no extraction five years following the removal of retention. Facial photographs and intraoral views are shown in Figs. 11 and 12.

The upper first permanent molar has its own diagnostic signal when it changes position in a forward direction. The difference is that the upper molar tends to rotate rather than to tip; if it shows no rotation, then in all probability it has not moved mesially (Fig. 14). Otherwise, for a nonrotated upper first molar in a deficient arch, the same diagnostic reasoning prevails:

vertical eruption from a crypt that is forward to begin with, no change in anteroposterior position during eruption, and its inability to move mesially when confronted with a concentration of teeth in the anterior portion of an inadequate arch. Thus, the upper first permanent molar also requires a well-developed arch if it is to move around freely. As it does, however, it rotates with the mesial surface turning to the lingual (Fig. 13).

This tendency to rotate is due in great part to the size and position of the large lingual root of the upper first molar. Since this sturdy root extends well up into an area of relatively dense alveolar bone, it resists bodily movement of the upper first molar as a whole. In this, it is more effective than the two smaller buccal roots combined. The result is that the lingual root acts as a center of rotation, causing the mesiobuccal cusp to turn lingually as it moves mesially. The large mesiolingual cusp of the upper first molar also is so located that it acts in a similar manner; it occludes securely in the central fossa of the lower first molar. This relation is so effective and unyielding that it again offers more resistance to displacement than the two smaller buccal cusps combined.

Thus, it is evident that changes in the position, inclination, and rotation of individual teeth are of the greatest importance in clinical diagnosis, especially in differentiating between cases that call for serial extraction in retarded arches and those that call for early treatment with no extraction in adequate arches.

The answer lies in early treatment, for interference with normal development is involved in these conditions. This is particularly true at the neck of the condyle, which continues to be the most active growth site in the mandible during the mixed dentition stages. Mandibular development remains a controversial issue. Nevertheless, if orthodontic treatment is capable of sparking increased growth in the condylar area, it must be done while the center is most active in the developing child. Certainly, it cannot be reactivated after condylar growth has ceased during the middle or late teens. Treatment, moreover, should be undertaken before a localized irregularity has been permitted to persist long enough to cause a permanent deformity in the deeper supporting structures of the face, and this refers to maxillary as well as to mandibular development.

The precarious course in similar deceptive irregularities is to undertake a program of serial extraction on the mistaken assumption that it is a panacea for all crowded Class I irregularities. This would mean acceptance of a probable "dished-in" profile at the end of treatment. Encouraging the mysterious force called growth is the more difficult treatment procedure and requires a greater amount of skill; yet the result is more satisfactory. Orthodontists must remember that teeth can be extracted at any time during treatment in these elusive cases but that, once extracted, they cannot be replaced. If an error in judgment is to be made, it is much more expedient to err in a conservative manner; only then can proper measures to correct the error be taken.

That this was not an extraction case was further confirmed by roentgenographic examination which showed missing third molars and wide spaces between the lower first and second molars. The picture in retarded arches is quite different; in these, the second molars are jammed up tight against the distogingival surfaces of the first molars. For these reasons, this irregularity was corrected not by serial extraction but by standard treatment with a full complement of teeth. It was not necessary to overexpand the arches to accomplish the correction in this nonextraction case, even though superficially it appeared originally to call for serial extraction.

The occlusal photographs of the final models show that arch form is fundamentally the same as in the original casts and that the dental arches are not wider than the alveolar bone will support (Fig. 13). This was due to an abundance of basal bone, laterally as well as anteroposteriorly. It is further evidence that, given normal supporting bone, the dental arches are fully able to develop sufficiently to hold any normal amount of tooth material. Unfortunately, the opposite does not hold true. Expanding a deficient dental arch will not, in turn, develop enough basal bone to support all the teeth in pleasing and permanent positions.

Intraoral views illustrate occlusal relations five years following the removal of all retention (Fig. 12). They show full correction of the rotations and inclinations of the upper and lower first molars and lower anterior teeth that have been able to maintain an even alignment directly over apical base.

Photographs taken at the end of treatment show that facial contours had not been altered and that the original facial pattern had been maintained (Fig. 11). Further photographs illustrate current facial contours. These postretention views show relaxed and passive musculature and evenly aligned teeth well positioned in relation to other facial structures. The profile photograph is of importance in the postretention analysis. Extraction in this deceptive case most certainly would have resulted in the objectionable "dished-in" appearance that so often is typical of nonextraction cases treated with extraction.

Consideration of facial balance and symmetry occupies a position of importance in every orthodontic diagnosis. It is possible that the straight profile has been overemphasized in our current concept of pleasing facial contours and that this has led to premature serial extraction as a pretreatment requirement. Yet, there was a time when a convex facial type was considered to be the essence of beauty. Even casual study of the paintings of the great Renaissance artists shows a preference for models with slightly recessive chins and foreheads that tapered backward as well as upward. In a previous age, the aquiline Roman nose and the Greek profile were considered a mark of distinction, but they also could be in harmony with other facial structures.

Hence, our current craving for a straight profile and a strong, aggressive mandible is not necessarily the ultimate in attractive facial contours. There are other forms of beauty, and we would be in error if we had only

one concept of pleasing balance and proportion in the human profile. A wide, generous smile, well supported with a full complement of teeth, may be more in keeping with what is observed constantly in the untreated normal dentition. This should be our goal and we should make every effort to achieve it.

CONSERVATIVE PRINCIPLES OF SERIAL EXTRACTION

The lessons to be learned from this and similar nonextraction corrections are (1) no extraction program should be undertaken without a thorough case analysis and a preliminary period of observation, (2) every malocclusion that appears superficially to be due to a reduction in arch length is not necessarily an extraction case, and (3) serial extraction, including removal of first premolars, in these deceptive cases would be a tragic error. The recommended procedure in similar elusive conditions is first to attempt comprehensive treatment without extraction. If, later, extraction appears to be the only solution, one should proceed slowly with the removal of teeth in a cautious and deliberate manner. This means retaining the first premolars until the last possible moment. Once extracted, they cannot be replaced. The inconsistency of growth is such that no orthodontist can be too sure at too early an age.

The term ***serial extraction*** implies the removal of selected teeth at proper intervals in an orderly manner over a prolonged period of time. It is a procedure of patience, of preliminary supervision without mechanical treatment, and of accurate timing in the extraction sequence. No new extractions are undertaken without first thoroughly reviewing the growth potential in each individual patient. In this manner, the orthodontist still has the opportunity of returning to comprehensive treatment without extraction if development unaccountably and unpredictably turns out to be favorable.

This word of caution is necessary because of several erroneous deviations from the authentic serial extraction concept. One of these actually includes extraction of the first permanent molars as a possible alternative in serial extraction. Equally serious, another advocates the immediate and simultaneous extraction on a mass basis of the four deciduous cuspids, the eight deciduous molars, and concurrently, at an early age, the enucleation of the four first premolars. The mass removal of from twelve to sixteen teeth cannot correctly be called serial extraction. Nor can it be considered good orthodontics, for it leaves young children dentally handicapped for a long period with only four molars and eight incisors.

This is not only a radical departure from generally accepted and tested procedures, but it also encourages undesirable developmental risks. Even when authentic serial extraction is necessary, premature removal of teeth involves the danger of retarding further growth in arches that already are deficient. Deep enucleation of first premolar buds at an early age also results in partial destruction of the lingual or buccal plates of compact alveolar bone. It is equally disastrous that prolonged absence of teeth in the premolar region permits the tongue to flow into the remaining spaces between the first molars and the lateral incisors. This results in a major problem in habit correction during the active stages of treatment.

To prevent these developments, the orthodontist has no choice but to place appliances for a prolonged period of years. Only by so doing can he hope to avoid complete collapse in occlusal relations, vertically as well as horizontally. On a higher level, these discrepancy cases can be so conducted that active treatment is reduced to a minimum at the conclusion of a conservative program of supervision with serial extraction.

SUPERVISED SERIAL EXTRACTION WITH NO MECHANICAL TREATMENT

This final case illustrates marked deficiency in structural development when compared to the excellent arches in the previous patient (Fig. 14). This is an authentic serial extraction case, and its progress, with no appliances of any kind at any time, is shown in a series of plaster casts and intraoral photographs. These were secured during a five-year period of continuous supervision with extraction.

The occlusal views of the original casts illustrate the usual diagnostic symptoms of insufficient arch length, early deciduous cuspid loss, a lateral displacement of the lower median line, and the lower right lateral incisor occupying the right cuspid space (Fig. 15). Although spaces exist between the upper incisors, arch length measurements showed that all four buccal segments were too short to accommodate the permanent cuspids and premolars between the lateral incisors and first molars.

In contrast to the previous case, there is no rotation of the upper first permanent molars and no increase in the mesial inclination of the lower molars. This indicates that these teeth have not migrated forward as in the nonextraction case, for if they had they would show the rotation and tipping that are characteristic of mesially displaced posterior teeth. If this reasoning can be accepted, it follows that if the molars have not moved mesially, the base does not exist to move them distally. In other words, the deficiency in anteroposterior development exists principally in the areas between the molars and the incisors.

It is highly questionable whether the posterior supporting structures would tolerate enough distal molar movement to create sufficient space for the blocked-out cuspids. Buccal displacement of the upper second molars is a common reaction when first molars are moved distally in an inadequate arch. It is equally questionable whether the lower posterior teeth can be moved even slightly distally. Any attempt to do so simply infringes on space reserved for the second and third molars, with a resulting impaction of the third molars in the ramus of the mandible. The deficiency exists mesially to the first molars. It is unreasonable to expect that extra bone growth can be created distally to the first molars to compensate for a growth failure mesially to the first molars; more likely, the first molars in these arches will drift slightly forward on the loss of the second deciduous molars. It is natural for them to do so, and this will occur whether leeway space and arch length are adequate or not.

Additional clinical evidence confirming a serial extraction diagnosis is found in the anterior segments of the dental arches. Here, the key is the

permanent lateral incisors: they either erupt to the lingual or they cause premature resorption of the deciduous cuspid roots. In well-developed arches they erupt in a normal position without disturbing the cuspids. Insufficient structural development causes this erratic eruptive behavior of the lateral incisors. Since the deficiency is present to begin with, early loss of the cuspids is the result and not the cause of a reduction in arch length. This, of course, is contrary to the orthodontic concept of a previous generation.

It is not within our powers to recover an extensive loss of growth in these cases, particularly when it occurs in the lower arch, no matter what the cause. The discrepancy between tooth mass and arch length is too great, and the second and third molars usually show a similar congestion distal to the first molars. Comprehensive treatment without extraction under these conditions will only cause a labial displacement of the lower incisors, the end result of which is relapse and crowding, gingival recession, and alveolar destruction. For these reasons, the most conservative measure in this patient was to extract so that the remaining teeth could erupt into the best possible positions over the available supporting bone.

Extraction of deciduous cuspids ordinarily is the first step in the serial extraction program (Fig. 14). Since three of these teeth already had been lost by natural means, the procedure at this time called only for the removal of the remaining lower left deciduous cuspid. Usually this results in a shift of the lower median line back to center, but in this case it did not do so immediately. Meanwhile, the upper left first deciduous molar had been lost prematurely and the right first premolar had achieved full eruption. It was, therefore, necessary to employ the second step in the serial extraction sequence in the lower arch only. This second stage calls for the removal of the first deciduous molars to permit the desirable early eruption of the first premolars.

The third set of casts illustrates the developmental changes that took place during the following year. Premature loss of teeth continued in the upper arch, followed by the prompt eruption of three of the premolars. Developmental changes were somewhat slower in the lower arch; the second deciduous molars retained their positions in a satisfactory manner, but the first premolars failed to erupt on schedule.

Of greater concern was the probable labial displacement of the lower cuspids. This called for more frequent examination. Intraoral views illustrate tooth position two months later (Fig. 15). The patient was now ready for the third and final step in the serial extraction procedure—the extraction of the four first premolars. Radiographs showed that the lower first premolars were close to the surface and could safely be removed. The lower second deciduous molars were left in place to serve their function of supporting the occlusion both vertically and horizontally.

Active treatment could have been undertaken at this time; yet, there were indications that further self-correction would result if complete freedom of development was permitted. The trend was favorable, and there were no

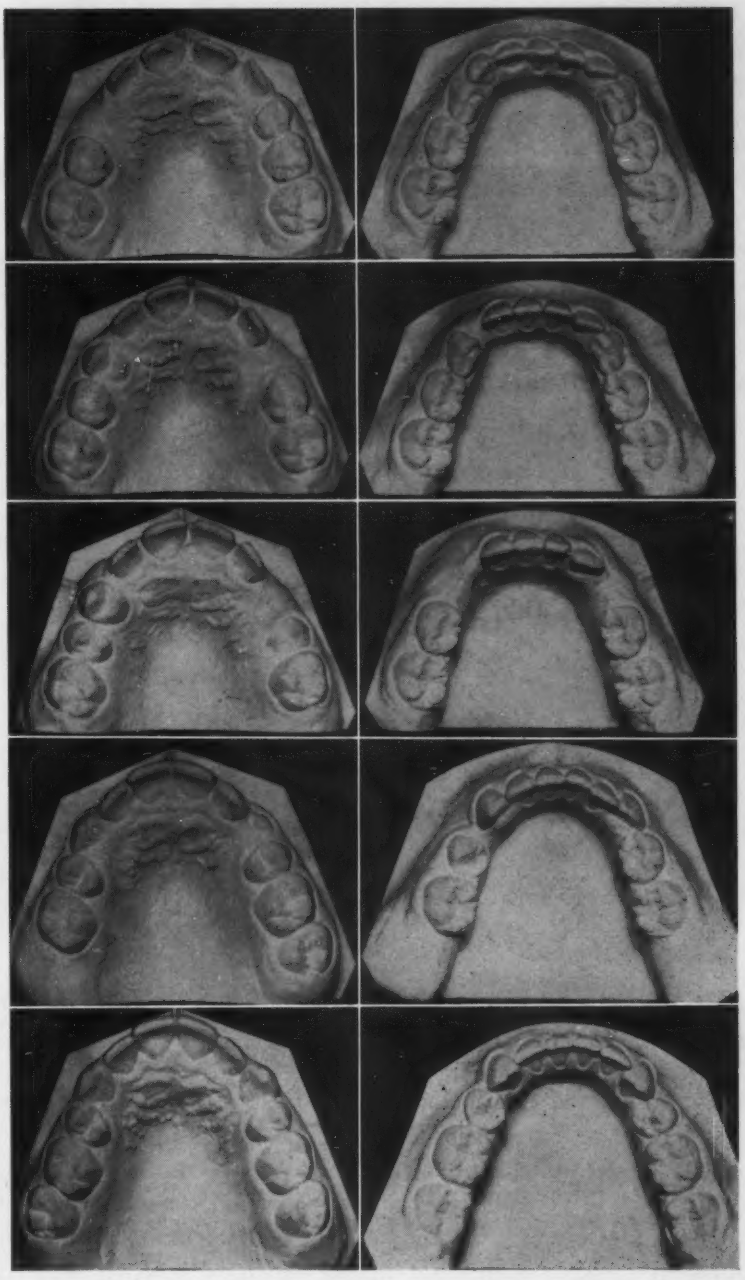


Fig. 14—Developmental sequence during a five-year period of supervision with serial extraction but with no orthodontic appliances of any kind at any time. The top casts illustrate premature loss of three of the deciduous cuspids. The remaining cuspid was then extracted, later the first deciduous molars, and finally the four first premolars. The second deciduous molars were left in place until they were lost by natural means. Occlusal relations are shown in Fig. 15.

particular risks that could not easily be recovered at a later date if future development failed to follow a desirable pattern. It was something that could be determined only by restraining the natural orthodontic inclination to apply active treatment at once. If treatment had been undertaken at this time, however, the lessons to be learned by observation and supervision in this typical serial extraction case would have been lost.

Fig. 15.—Intraoral photographs of case shown in Fig. 14. The center views illustrate occlusal relations at the time of the extraction of the upper first premolars and the surgical removal of the lower first premolars. This was done to encourage the eruption of the permanent cuspids in a distal direction. No orthodontic appliances were used at any time.

For example, one of the observations concerned the positions of the lower first molars after the extraction of the first premolars and the subsequent natural loss of the second deciduous molars. In the adult dentition, extraction of the second premolars usually results in an increased mesial inclination of the lower first molars. Yet, in this retarded serial extraction case these first molars appeared to have a distinct distal inclination when related to the occlusal plane. Only further supervision would reveal their future course on the eruption of the second molars.

The final set of casts shows continued favorable eruption of teeth with no assistance whatever from orthodontic appliances. Spaces between the upper incisors have now closed of their own accord. Recent intraoral photographs illustrate current occlusal relations (Fig. 15). Overbite and overjet

are within normal range, and the posterior teeth are in acceptable functional positions. Equally important, the teeth have assumed a reasonably normal alignment directly over the available supporting bone with no mechanical assistance of any kind. It is questionable whether active treatment could have achieved more than minor improvement in occlusal relations.

Study of the facial contours is a necessary part of any serial extraction program (Fig. 16). Recent photographs illustrate relaxed and passive musculature and a pleasing appearance. Yet the profile view shows supporting structures that are not sturdy enough to have contained thirty-two teeth in good alignment and still retained its symmetry. Interest in the future development of these facial structures, untouched by appliance manipulation, is as great as that of the denture itself.

Fig. 16.—Original and final photographs of patient shown in Figs. 14 and 15. Serial extraction made it possible to maintain facial balance and proportion in relation to other cranial structures.

At this point, searching questions should be raised regarding professional responsibility in the diagnosis and treatment of these discrepancy cases. The purpose of serial extraction is to intercept certain severe forms of malocclusion in the mixed dentition before they become fully matured deformities in the permanent dentition. It is not intended as an active treatment procedure; its objective, instead, is to encourage a measure of self-correction in order to shorten the ultimate period of mechanical therapy.

This calls for cautious and deliberate extraction in an orderly serial manner. If growth exceeds expectations, it is still possible to return to conventional treatment with a full complement of teeth; the patient has not yet been

committed to but one treatment method with the immediate extraction and enucleation of several deciduous and permanent teeth. Meanwhile, no unnecessary risks are taken: ample time remains for proper treatment, and the orthodontist is able, through continuous supervision, to arrive at the correct solution in a sound and judicious manner.

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REMOVABLE APPLIANCES

A Suggested Planning Board for 1964

Walter J. Furie, D.D.S., Long Beach, Calif.

INTRODUCTION

It WOULD be presumptuous of me to go into a long dissertation on early diagnosis and treatment. I could refer to no finer investigators than your own neighbors and fellow orthodontists. Two with whom I am familiar are Drs. Jac Duyzing and Arne Björk. Dr. Duyzing's fine paper on "The When and How of Early Treatment, Using Removable Plates so as to Do the Greatest Amount of Good to the Most Children" was presented before the American Association of Orthodontists in 1951. At Brussels each year the outpatient clinic has 4,000 patients under treatment with simple removable plates and activators. While in Brussels, I called on Dr. Lucien de Coster who is in charge of this clinic. We do not have a clinic of this magnitude in the United States, but we are anxiously hoping that this may be a part of the answer to the big challenge of how to get some preventive service to the masses of children. Dr. Duyzing takes us back to infant feeding at the mother's breast. May I refer you to Dr. Walter Straub's most recent work on perverted swallowing habits and tongue-thrusting; he makes it very clear that these deforming habits are started not at the mother's breast but at the nipple of the nursing bottle.

European orthodontists have done so much research and have contributed so much to orthodontics that I have made this long trip to observe, to learn, and to meet you men.

We certainly must pay tribute to the untiring efforts of Dr. Arne Björk on the "Variability and Age Changes in Overjet and Overbite Cases" and his follow-up study of patients under observation, first at 12 years of age and again at 20 years of age. What a tremendous undertaking! This is truly research by a scientist.

In the United States we are constantly being reminded that the dental schools throughout Europe compare very favorably with the best that we have in America. Our medical and dental problems are the same, so we all speak the same language in that respect.

Read before the Swedish Orthodontic Society in Stockholm, Sweden, June 7, 1958. With modifications, read before the fiftieth anniversary meeting of the Swedish Dental Association in Stockholm, Sweden, June 8, 1958. Clinic and instructions on appliance construction before the Eastman Clinic, June 9, 1958 (Dr. B. Kjellgren in charge).

I started out to be an engineer so, you see, I was mechanically minded. My interest has been the mechanics of tooth movement, and the result is that I have drifted from one appliance and type of treatment to another, starting thirty-five years ago with the ribbon arch. My next venture was the labiolingual technique with the pin-and-tube appliance. Then I went on to the high labial appliance, McCoy's open-tube appliance, and the Universal appliance. Last, but not least, was the twin-wire appliance. I have enjoyed the privilege of presenting clinics with all the originators of these appliances but Dr. Angle; they are all fine, inspiring men. Lest we forget, a lot of orthodontists employ a popular technique that is a combination of all techniques, having in mind the idea that no one appliance is a panacea for all conditions.

In my opinion, this restlessness or looking for a better way is a healthy sign. May I quote Ralph Cordiner, President of General Electric Company: "Civilization is moved forward by restless people, not by those who are satisfied by things as they are." Because of this restlessness, we are not traveling by horse and wagon, train, automobiles, or even propeller-driven airplanes. Now it is jet planes, and next it will be guided missiles. That is progress! A museum of transportation is very interesting; there is one at Munich, Germany, starting with the chariot.

It would take days to go through the Smithsonian Institution in Washington, D. C., just to see the progress of the last century.

Museums of progress are inspirational if they make you think about your own line or profession. Just what progress have we made in the mechanics of orthodontics? As long as I can remember, we have been using the same bands, the same cement, and the same wire to snap into a wide variety of attachments. I know of men who still use the Angle ribbon arch and swear by it. Orthodontists are not ready to display mechanical progress at the Smithsonian Institution. Orthodontics is on the threshold of progress. All we need is the inspiration from such men as Andresen, Schwartz, Holtz, Nord, Crozat, and many others—men who have vision and who have been working with removable appliances. Then give us a dozen dynamic men with unlimited vitality—men like Angle, McCoy, Oliver, Johnson, Atkinson, Tweed, and your long list of scientist-orthodontists from Europe, like Oppenheim and Simon. Orthodontics would soon redeem itself and be as modern as everything else around us.

To date, removable appliances have had the individual attention of only about a dozen men, each working with his own appliance. Removable appliances have a pretty good start, for Dr. Crozat has been perfecting his appliance and technique for more than thirty years. Dr. Hugo Jackson's removable appliance, developed before Crozat's, was bulky and crude by comparison. Nevertheless, it was used to advantage by Dr. Jackson and his followers, and it has been a valuable steppingstone. We sincerely hope that the Crozat appliance will be only the beginning of further orthodontic progress. If it will just start us thinking in that direction, our time will have

been well spent. After my years of experience with all types of appliances, and after due thought and deliberation, I can say that the Crozat appliance comes very close to being the answer to the orthodontist's hopes and prayers. The only written reports on the Crozat appliance to date are a case report by Dr. Samuel Gore and a very nice article by Dr. Andrew Jackson; both appeared in the AMERICAN JOURNAL OF ORTHODONTICS. Our efforts have really been pioneering—a delightful, interesting, and worth-while challenge.

DR. GEORGE CROZAT

Dr. George Crozat is a fine gentleman, student, and teacher. While still a senior in college, he was advised by his dean to investigate the straightening of teeth without bands, as the dean had observed it done by Dr. Walker of New Orleans. Dr. Walker had been dead for more than two years, and there was not a Walker appliance to be found. All Dr. Crozat had to go on was the dean's description of what he thought the appliance looked like. He did not even know the size or type of wire used, so he started from scratch. Working with the precious metals, he worked out the formula and the size or gauge of wire for the most effective use. Dr. Crozat then had to *perfect* his concept of treatment, as the orthodontic books of that day did not agree with what he was able to see happening.

As Dr. Crozat has been using and perfecting this appliance for more than thirty years, it is natural to ask: "What is wrong? If it is as good as we say it is, why is it then not the most popular appliance in use today?" I consider this a very sad commentary.

About twenty-five years ago, Dr. Crozat appeared before the American Association of Orthodontists full of enthusiasm and vitality. I was not there, but I can visualize another Oliver, Johnson, McCoy, or Tweed making the presentation that it took him months to prepare. Then they lowered the boom! His paper was never published in the JOURNAL. Thus, a hero was born and crucified on the same day, and this act apparently put out the fire of enthusiasm. There has been no written word to this day by George Crozat.

The editors of the orthodontic journals of that day were not publishing revolutionary articles or fairy tales. We were all concentrating on and confining our efforts to the new pin-and-tube appliance and Dr. Angle's new ribbon arch. We were not ready for fantastic things like sputniks, guided or I.C.B.M. missiles, atomic submarines that would go under the Polar Ice Continent, or removable orthodontic appliances. Men with such ideas were considered visionary, and their thoughts had to be put into such fiction stories as Jules Verne's *20,000 Leagues Under the Sea* or in the comic sections of our daily papers, as Buck Rogers' "Interplanetary Travels." Dr. Victor Hugo Jackson was born sixty years too soon and Dr. Crozat thirty-five years ahead of the times. Orthodontics has had to undergo a natural transition. Thomas Edison's great philosophy was "There's a way to do it better—find it." He might have added, "Don't expect miracles—when people are ready it will be accepted but not before."

Orthodontists are intelligent men. Every day of our lives we cannot help but think that there must be a better way and an easier way to accomplish our task. Proof of this is that many orthodontists have made trips to New Orleans and spent a day or a week at Dr. Crozat's office, only to return home to try to use the appliance and find that they were not well enough trained to do it.

In 1939, I spent a week in Dr. Crozat's office and returned to my office very enthusiastic and anxious to try a few cases. My mistake was that I did not pay enough attention to appliance construction, and I had no one to talk to. My appliances were poor fitting, the patients would not wear them, and the appliances were lost or stepped on, so I just took the easy way out and went back to banding teeth.

If we are always going to have orthodontic appliances, let us, as orthodontists, put down in black and white what we think would be our new contribution to humanity.

First, let us make a survey and find out what are the objectionable features of having teeth straightened:

Patient: There are so many bands, and the teeth hurt.

Parent: The cost, the child is nervous and does not eat well.

Dentist: Unnecessary extraction of premolars, decalcification and decay of banded teeth, and hyperemic gum tissue.

Orthodontist: There should be an easier way.

Orthodontics needs a little research and positive action. Now that we know the objectionable features of present-day orthodontics, let us plan for the future by submitting a list of "musts" for our new age of modern living:

1. An appliance that can be made by the orthodontist or laboratory technician and snaps into place like a gold inlay the first time it is tried in.

2. To be able to say to the patient: "If this appliance makes your teeth sore, it is too tight. Don't wear it, bring it back."

3. To be able also to say to the patient: "Wear the appliance while eating—that's important—but remove it after eating to rinse your mouth. Twice a day, remove the appliance to brush your teeth thoroughly and clean the appliance; then you will have no decalcification or decay due to appliances. Appliances are not lost or stepped on if they are in the mouth."

4. The appliance of the future should work from the lingual aspect to upright the molars, premolars, and cuspids. This, in turn, relieves the crowding of the anterior teeth. Rotation of upper or lower anterior teeth is caused by crowding. When the crowding has been relieved, spaces appear between the teeth. The normal functions of lips and tongue, as well as chewing, would eventually take

care of rotated teeth, but we cannot wait, so we may place finger-springs to assist in our work. The mesiodistal relationship (Class II, Angle) may be corrected before the appliance is placed on the anterior teeth.

5. The orthodontic appliance of the future should be so simple that the orthodontist, with a good dental assistant and laboratory technician, can and will conveniently handle three or four times the number of active cases that he handles with the present appliances. We need this as the income of orthodontists who are making an honest effort to do good work has not kept up with the increased cost of living. General dentists are now grossing more than the conscientious orthodontist.

6. With an improved technique and concept of treatment, it will no longer be necessary to hide failures or to apologize for poor-fitting bands or appliances or decalcification and decay of teeth due to bands. The orthodontist will be able to invite the visiting orthodontist into his office and, as one artist may talk with another artist, show his friend, with pride, the living pictures of his numerous creations.

I recently had the pleasure of attending the première showing of the latest in jet planes in the United States. We were told that the public is eager to accept what is new, that U.S. industry spent, on research and growth, $2\frac{1}{2}$ billion dollars in 1948, and 10 billion in 1958, that new and improved products have revolutionized our way of living; that invention and research are the rebellion against the stupidity of status quo. It was the new DC 8, all jet, at the Douglas Plant in Long Beach, California. It cost 200 million dollars to build the original plane. The general manager told us that this is just another step in the right direction to progress. Already on the drawing board for 1964 is a controlled guided missile that will take off from Cape Canaveral, Florida, circle the earth, and come back for landing. If, for some reason, it is waved off, it will circle the earth again. This missile is able to circle the earth four times without refueling. Each circling requires one hour and ten minutes.

That huge plant is like a dental college overflowing with young students fired with vision. They will not be told that there is only one way to straighten teeth, that it requires a full banding, and that they should not try anything else. The young scientists at the aircraft and guided missile plants are told that the sky is the limit and to shoot for the moon. If our dental schools had only encouraged such pioneers as Simon, Lischer, Rogers, Dewey, and Crozat, as well as the human dynamos previously mentioned, we too would be shooting for the moon.

FIVE-YEAR PLAN

Orthodontics could use a five-year plan, a drawing board of the future. It should be no crime for us to discuss the orthodontic appliance of the future.

So get out your drawing boards for 1964, and we will start off with a few predictions and ask others to add to them.

With the orthodontic appliance of the future, it should be possible to recognize the limits of physiologic tooth movement and to give growth and bone changes a chance to catch up with tooth movement. It should not be possible to drag teeth through the cortical plate of bone. At frequent intervals appliances may be removed to allow the teeth to settle to a functional occlusion, or appliances may be worn a few or several hours at night. This interval of rest may be for only a month or two, or it could be several months. The job that you contracted to do in two years of active treatment may be spread over three or four years, depending on the tooth-erupting age, the mental attitude, and the physical health of the patient. The two years of active treatment do not have to be consecutive, according to Oppenheim. In fact, ten months' active treatment a year is healthy therapy for the patient (as well as the orthodontist).

ADULT TREATMENT

With the appliance of the future, a whole new field of operation will be opened up. That is adult orthodontics.

Adults from 20 to 50 years of age are certainly cooperative and appreciative. The teeth and tissues respond to the same light pressure as those of a 12-year-old child. The orthodontist does not worry about retention, as the adults are perfectly happy to wear the appliances at night for the rest of their lives if necessary. A disfiguration that is annoying to the successful man or woman appearing before the public is the large space between the upper central incisors, or all of the anterior teeth. It is perfectly amazing how well this type responds to treatment. Now it can be done, as no appliances are in sight.

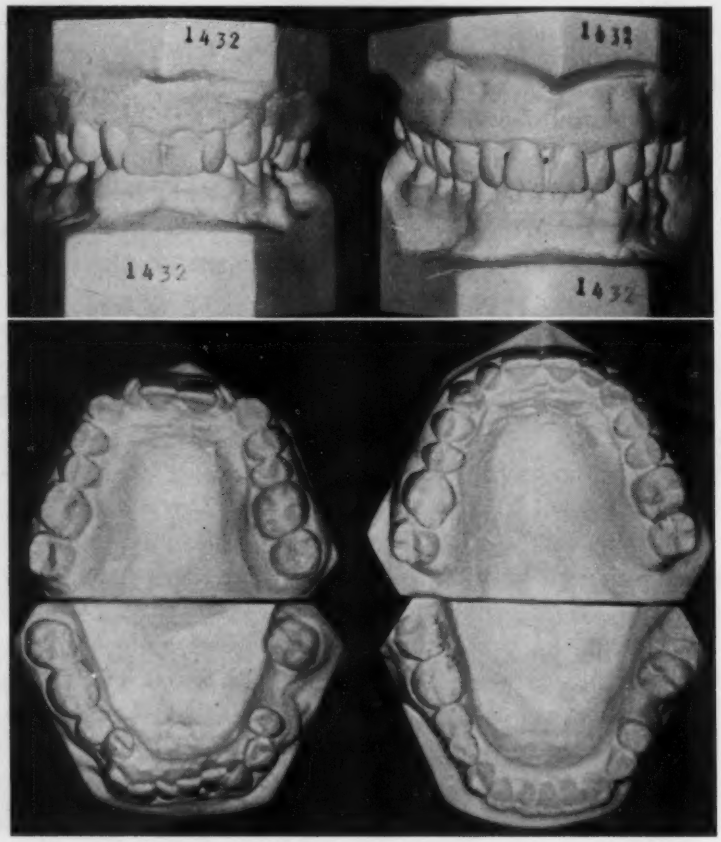
One of the most annoying conditions I know of occurs in persons who have had perfectly beautiful teeth all through their youth. When they reach the age of 30 or 40, their lower anterior teeth start to crowd and overlap. If something is not done at this time, the upper teeth break their beautiful alignment and the central and lateral incisors are forced out to the labial or lingual aspect. If the dentist knew that a removable appliance could be placed on the lingual surface of the lower teeth to stop this crowding and that, with a little time, the teeth could be beautifully aligned again, he could save this mouth and have a very happy patient. Adult cases could have treatment only with removable appliances.

First impressions are lasting impressions. Adults in responsible positions are very alert concerning their appearance and will go to extreme ends to have corrected any condition that bothers them mentally or any facial disfiguration that might influence that first impression. Certainly the thought of "false teeth" comes within that classification.

The photographs that I am about to show are "before and after" views from the first fifty cases we treated with the Crozat removable appliance.

You will see that the before-treatment views are of plaster models. My apologies. It was only after a great number of very satisfactory results that we decided to purchase modern photographic equipment to make a record of orthodontic results that I did not think possible with removable appliances just a few years ago.

CASE 1.—A nice-looking schoolteacher, about 38 years of age, was advised by more than one dentist that it was only a matter of time until she would lose all of her teeth. She had a close-bite, the lower incisors were a constant source of irritation to gingival tissue on the lingual surface of the upper central incisors, and the gingival tissue of the lower incisors' labial surface was hypertrophied and receded due to irritation from upper central incisors. This patient was desperate; she had been trying since she was 20 years old to have her bite corrected. As she lives north and east of San Francisco, she had to make an eight-hour train trip (each way) once a month to come to Southern California. This woman would take all the risk because she needed help.



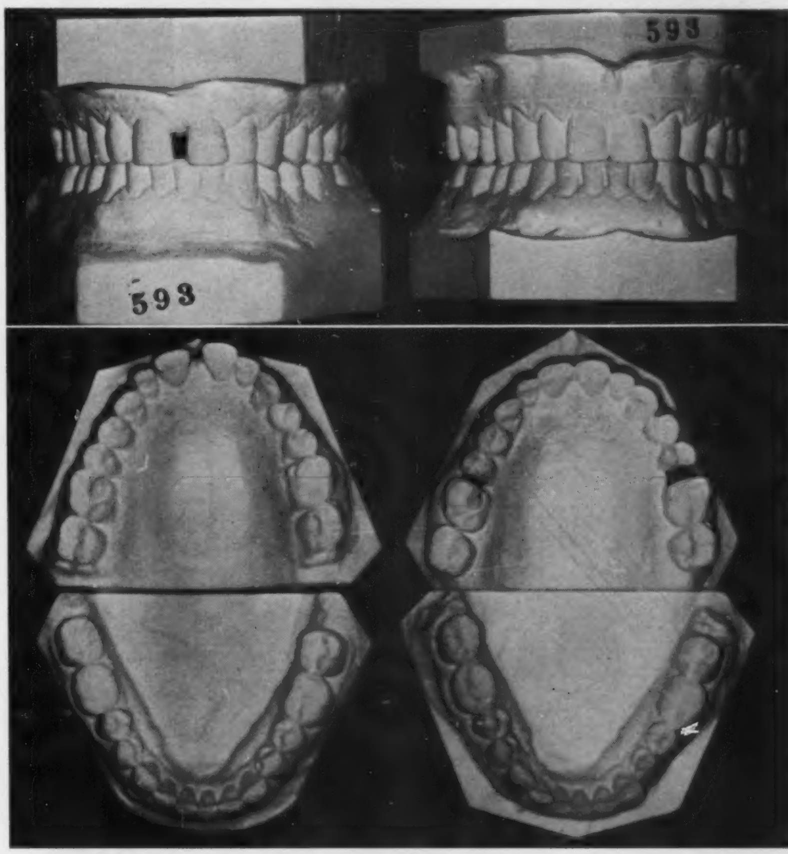
A. *B.*

Fig. 1.—Case 1. Progress report. *A*, Before treatment. *B*, After eighteen months of active treatment.

Plaster models before treatment are shown in Fig. 1, *A* and photographs taken after eighteen months of active treatment are shown in Fig. 1, *B*. One period of three months we did not see patient, as she underwent surgery, but she continued to wear appliances. This

is a progress report, the protrusion has not been completely corrected and may not be correctible. Recent x-rays reveal no root resorption or further destruction of bone due to tooth movement. A recent letter from Mrs. C. indicates that she is a very happy and pleased patient, both physically and mentally. Our mission has been accomplished.

CASE 2.—A 38-year-old businessman has been wearing a cast-gold plate with overlays on the molars to take pressure off anterior teeth. His upper and lower incisors showed severe occlusal wear, and there was separation of all upper anterior teeth due to constant pounding during mastication and on closure. Fig. 2, *A* shows the plaster model before treatment.



A. *B.*

Fig. 2.—Case 2. *A*, Before treatment. *B*, After treatment. Note spaces between upper premolars and molars due to mesial movement of teeth to close spaces of central incisors. Gold inlays will hold space.

A Crozat appliance was placed on the upper teeth only (Fig. 2, *B*). Treatment involved mesial movement of incisors, cuspids, premolars, and molars. Incisors, cuspids, and premolars were brought forward to the median line. Large silver fillings of six-year molars were to be replaced with gold inlays, with contact points built up to fill newly acquired space and to hold all teeth in contact. On your next trip to Knott's Berry Farm, meet Mr. Oliphant, Mr. Knott's son-in-law, and one of the head men of that organization. He is a happy and proud patient.

CASE 3.—This female patient was a 23-year-old schoolteacher. Nice looking until she smiled, she was unmarried and worried about her prospects.

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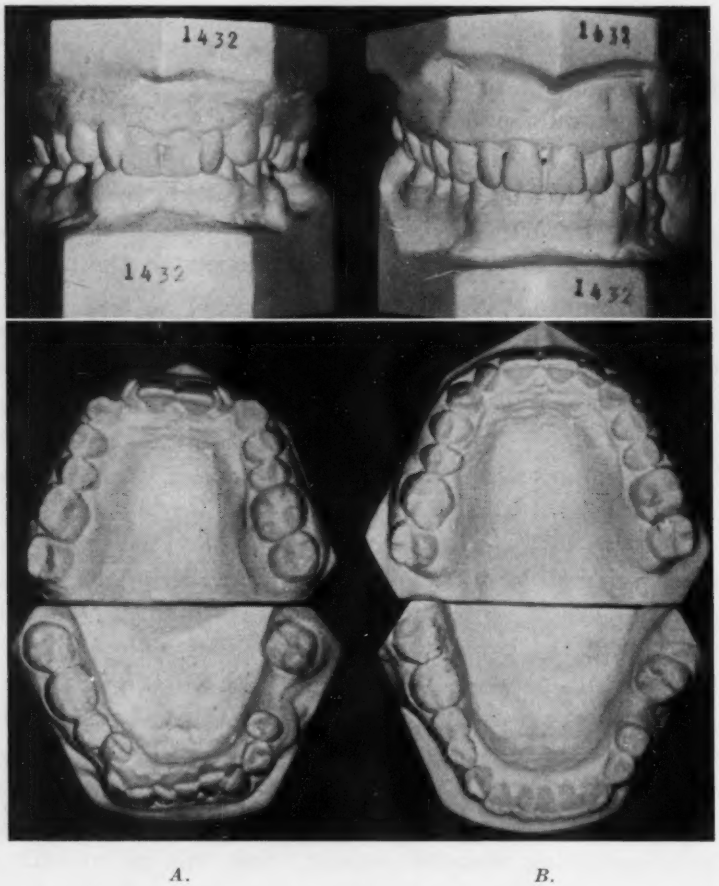

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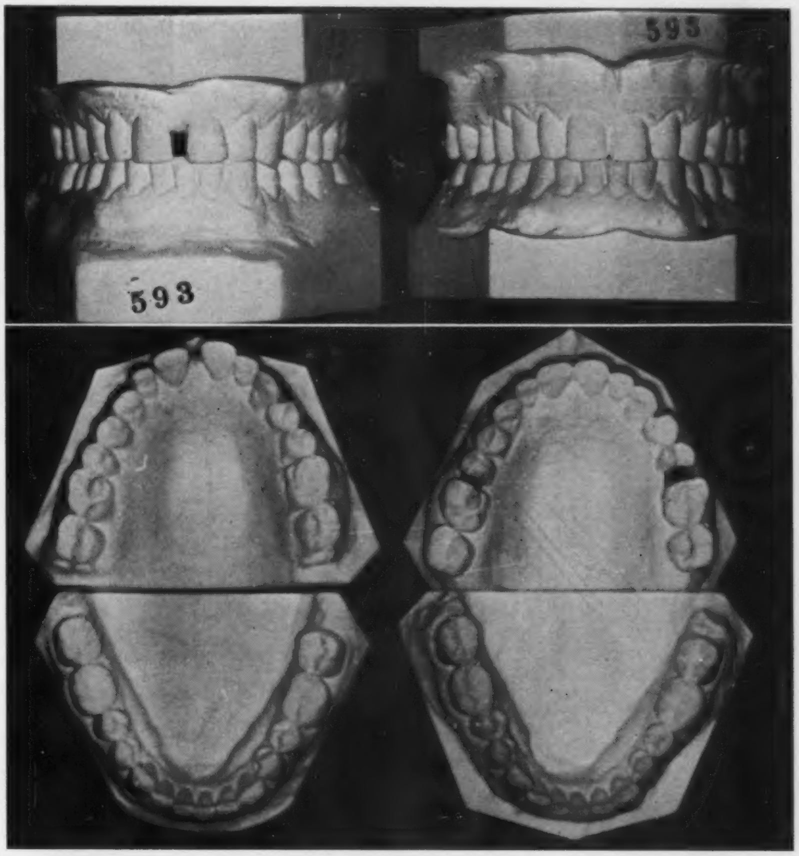

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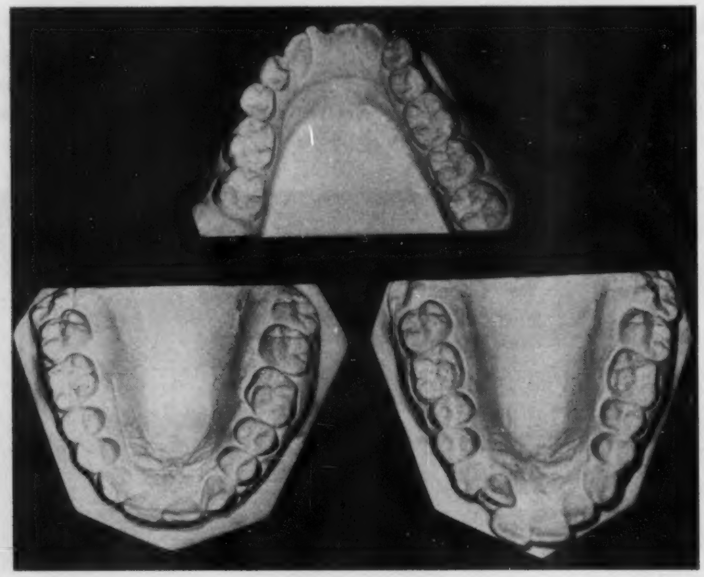
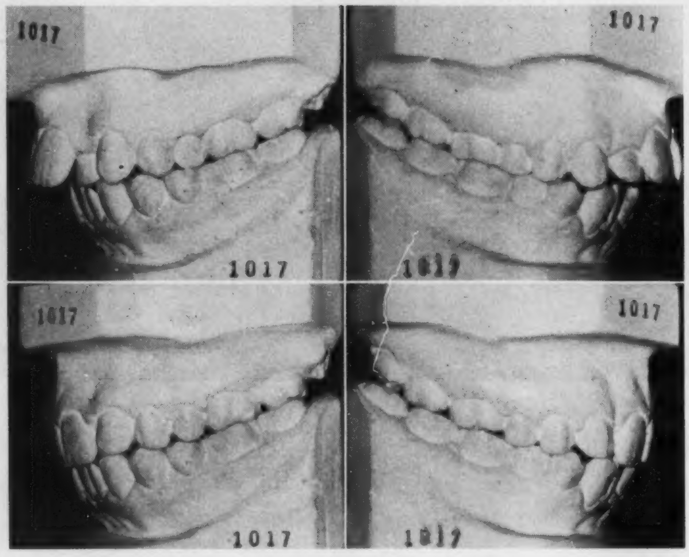
Case 3.—This female patient was a 23-year-old schoolteacher. Nice looking until she smiled, she was unmarried and worried about her prospects.

History: The lower left central incisor and the right lateral incisor were extracted to relieve crowding and overlapping when the patient was 12 years of age. Maxillary protrusion was marked.



A.



B.

Fig. 3.—Case 3. Treatment involved extraction of perfectly good upper lateral incisors and closing of spaces. Only upper teeth were treated. Note early loss of two lower anterior teeth and space closure.

Treatment: The upper right and left lateral incisors were removed, and the spaces were closed. Only the upper dental arch was treated, as the lower teeth looked very good.

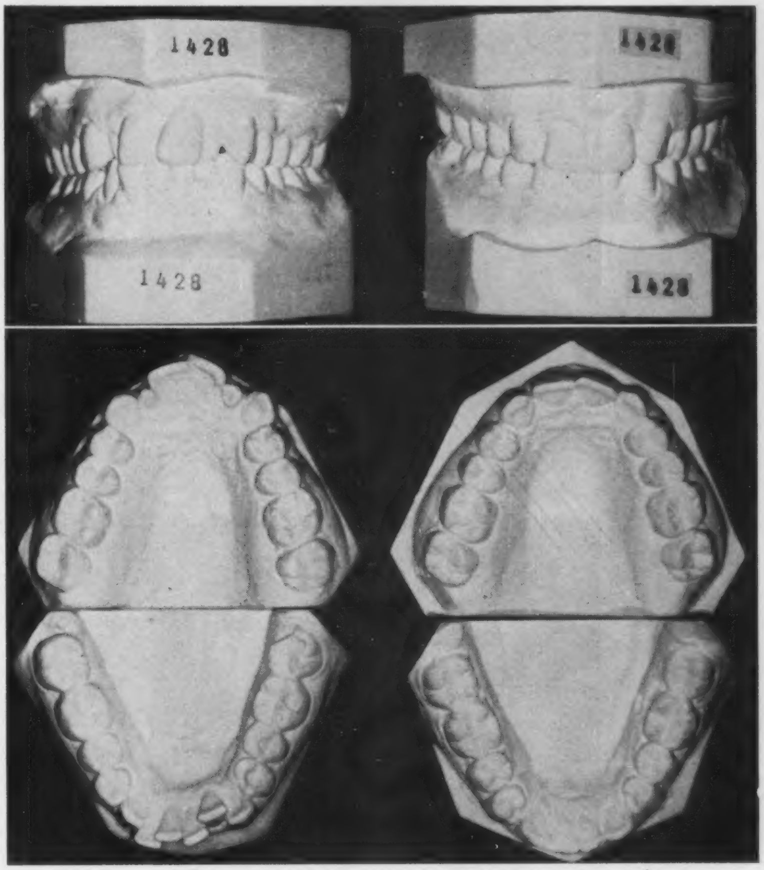
At 25 years of age the patient took a two-week trip to Honolulu, where she met and married a captain in the United States Air Force. Mission accomplished.

CASE 4.—The patient was a woman of 40 years plus, who is married and has a 23-year-old daughter and a 21-year-old son. She was very good looking until she smiled and showed her teeth. No one had ever seen her teeth, as she used handkerchief very nicely when smiling.

Diagnosis: Neutroclusion. The lower anterior teeth were very crowded and overlapped due to peg-shaped upper lateral incisors, which were also crowded.

Treatment: The successful closing of spaces in Case 3 tempted me to remove the peg-shaped upper lateral incisors and both lower lateral incisors and close spaces.

The woman was an excellent patient and did not mind wearing removable appliances. She facetiously reports that she was the subject of conversation at all her bridge parties and removed her appliances on numerous occasions just to show how simply they were cleaned and replaced.



A. *B.*

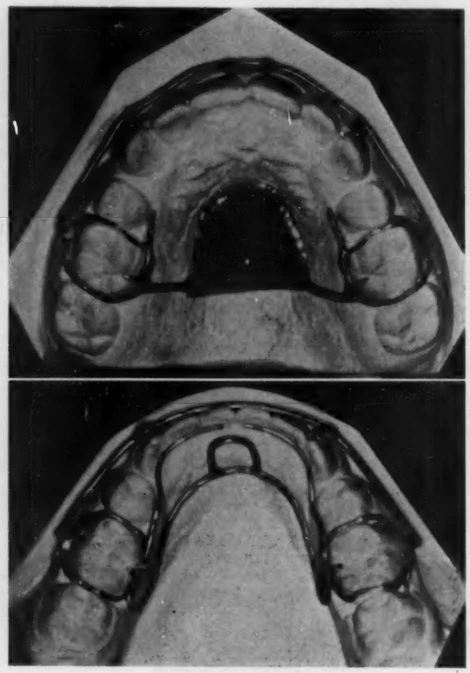
Fig. 4.—Case 4. Two upper and two lower lateral incisors were removed; spaces were closed. *A*, Before treatment. *B*, After treatment.

Report: Three years after eighteen months of active treatment, the patient's tooth alignment is very satisfactory. The patient is happy and cannot sleep without her appliance, as she has a feeling that her teeth are moving. She can smile again without the use of a handkerchief.

CASE 5.—Fig. 5 shows upper and lower plaster casts of a case in which four first premolars in a 14-year-old boy were extracted. A Crozat appliance as used to close spaces. (Notice how lower base wire has been raised to prevent irritation of gingival tissue as spaces

have been closed.) A lower labial appliance was used but has been removed. Appliances are now used for retention, at night only. After three years of part-time retention, teeth are very satisfactory.

A.



B.

Fig. 5.—Case 5. Four first premolars were extracted and appliances were used to close spaces. *A*, Upper Crozat appliance with acrylic palate rest to prevent molars from tipping. *B*, Lower Crozat appliance with tongue rest to aid forward movement of molars.

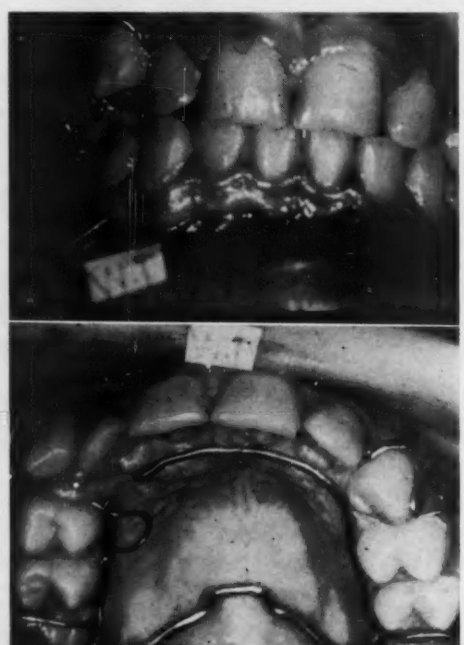


Fig. 6.—Crozat appliance in action. Unilateral mesioclusion on left side. Lingual finger-spring from opposite side for anterior movement of incisors. Recurved spring for rotation of left first premolar and hook for intermaxillary elastic.

CASE 6.—In this case a Crozat appliance was used to correct a unilateral mesioclusion on the left side. A lingual finger-spring from the opposite side was employed for anterior movement of incisors; a recurved spring was used for rotation of the left first premolar and a hook was used for intermaxillary elastic.

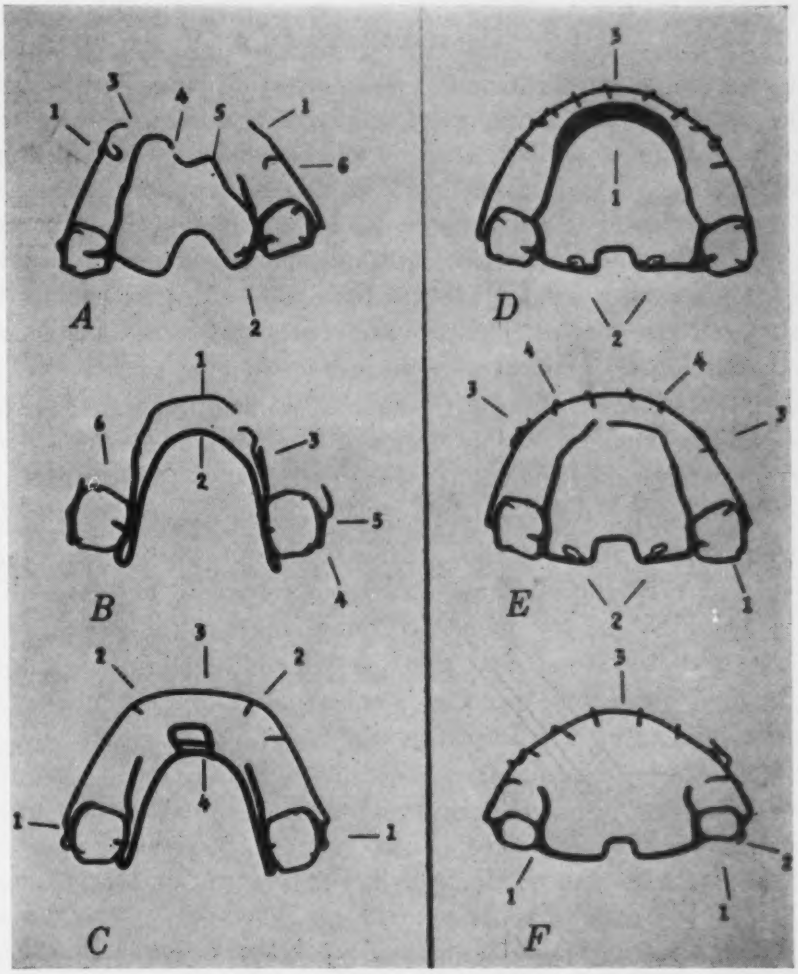


Fig. 7.—*A*, Upper Crozat appliance. *1*, Hooks for intermaxillary elastics; *2*, hook for elastic to buccal side of lower; *3*, finger-spring to high cuspid; *4*, finger-spring to lingual side of lateral incisor; *5*, finger-spring to cuspid in palate; *6*, curved finger-spring to premolars.

B, Lower Crozat appliance. *1*, Finger-spring to lingual anterior teeth; *2*, lingual bar; *3*, finger-spring to right cuspid; *4*, ligature hook; *5*, molar clasp; *6*, molar crib.

C, Lower Crozat appliance. *1*, Hooks for intermaxillary elastics; *2*, finger-springs for uprighting and rotating cuspids and incisors; *3*, low labial arch; *4*, tongue rest.

D, Upper Crozat appliance. *1*, Acrylic bite plane; *2*, hooks for rubber ligature, tongue exerciser; *3*, labial arch with finger-springs.

E, Upper Crozat appliance. *1*, Cribs to molar teeth; *2*, hooks for elastics; *3*, hooks for intermaxillary elastics; *4*, finger-spring for controlled movement of anterior teeth.

F, Upper Crozat appliance. *1*, Cribs to premolars; *2*, clasp; *3*, labial arch with finger-springs.

Fig. 7, *A* to *F* shows Crozat appliances that have been used and discarded for new appliances or because the case was completed.

Without seeing the patient, it is quite easy to tell just what the orthodontist is trying to do by studying the appliances.

Fig. 7, *A* indicates that the orthodontist was treating a bilateral maxillary protrusion or mandibular retrusion (Class II, Angle) with a cross-bite on the

left side; the left cuspid is lingual to normal, the right lateral incisor is lingual to normal (this crowding would indicate a narrow upper dental arch), the right cuspid is high and anterior, and there is also a cross-bite on the left side. The numbers on the illustration indicate our means of diagnosis.

APPLIANCE CONSTRUCTION

The construction of the Crozat appliance is all-important. If the appliance does not snap into place like a gold inlay or if the clasps cannot be adjusted so that intermaxillary elastics will not dislodge, then it is necessary to make a new one. The first important step is preparation of the molars for the cribs and clasps. If only the occlusal half of the molar is out of the gingival tissue, you had better resort to bands or send the patient to your favorite competitor who uses bands. He will hate you for it, but you are honest in saying that you are unable to use the removable appliance on this case. You must be able to trim your plaster around the molar so that the crib can engage the largest dimension of the tooth. In preparing the plaster tooth, keep in mind a slippery marble; remove the minimum amount of plaster necessary to extricate the marble from the socket with a pair of tweezers.

There are many advantages to using precious metal and gold solder in constructing appliances. The clasps, cribs, and finger-springs are high-fusing, high-spring, 12 per cent platinum 0.028 round wire. The material fuses at 2,400° F. The high and low labial arches and arms to the lingual of the premolars are size 0.040 round, and the base wire is 0.051 round; these do not have to be high-spring but may be 3 per cent platinum, a tough, temperable, light, gold-colored wire. The fusing point is 1,668° F.

We have used chromium alloy wire in the past very successfully. It is necessary to select a brand that solders readily with 14K gold solder. With the chromium wire, we did have to use high-spring precious metal wire for the cribs and clasps. The advantage was that it did not lose its spring on soldering and was easy to repair, as the breakage, if any, was on the crib and clasp. One should bear in mind that all the grief will come from poorly fitted cribs and clasps.

If the lower second premolars are badly rotated, the tooth is banded and a hook is placed on the band for rubber ligature stretched distal to the molar crib. Occasionally, we band upper or lower cuspids in extraction cases, if those teeth have been badly tipped and rotated. As a result of soldering 0.022 round wire about 1 inch distal to the cuspid, the patient is able to snap the wire into the open tube on the cuspid band; the light rotating and uprighting pressure takes care of positioning the cuspid nicely. All other rotations and tips are corrected with the 0.028 finger-springs.

CONCLUSION

If something were to be done about the planning board of 1964, there would arise this question: "How would it be possible to train the present

orthodontists to this new technique?" Well, here is one plan that we would like to start in the United States. I am here primarily to interest similar groups in Europe.

We must first interest a large group and give them entire credit for the research and success of their efforts. We must show them results that will excite and challenge their imagination. The Dr. Charles Tweed group of the Angle Association must be recognized as the largest, hardest working study group in the United States, with over 300 active and hard-working members. I have talked to many of these young men and have yet to find one who will say that orthodontics cannot be done with removable appliances; by their very actions, they indicate their hopes that it can be done and that they can do it. We have their interest; now for their cooperation.

We would like to interest different study groups, as we need men who have brains, fire, and enthusiasm and men who are teachers of cephalometrics, as their records would be conclusive and accepted. We would like to interest such a group in Stockholm and elsewhere in Europe, and I assure you that we will be able to send instructors to lecture and teach the mechanics and concept of treatment. With this organized backing, we should have no trouble raising funds—private, state, or federal—to finance the project.

I submit the Crozat appliance as a basis with which to start in planning an appliance of the future. If the case is amenable to treatment with bands, we can show you that the removable appliances, in the hands of a skilled orthodontist, will do the job just as well and possibly better. We know that the patient will be happier. This we know for sure: The people are ready for something new in orthodontics. The big question is: Are the orthodontists ready? Can we forget the past and have our young men work out their own future?

REFLECTIONS OF OBSERVATIONS IN EUROPE

I was amazed to see the extensive use of activators throughout Europe and was anxious to get home and give them a thorough test in my practice. After five months, my report is very favorable. I have now instituted cephalometrics; my future report on both activators and Crozat removable appliances will be with head pictures and tracings as taught by Steiner. My opinion is that the growth and change must come from the condyle and ramus. How else can we account for the correction of cuspal relationship of six-year molars in extreme Class II cases in just four or five months' time?

The Norwegian technique, or Andresen appliance, is my answer for treating mixed dentition cases. It is a simple functional appliance; it must be worn twelve to fourteen hours, nights inclusive, to stimulate the tissues to normal growth and reduce protrusions of upper anterior teeth. It is the means of doing some good for the greatest number of youngsters; its use will satisfy the anxious parent of the young patient that something is being done. It is not as highly refined as the Crozat appliance, so for that higher degree of perfection, from an esthetic point of view, we will still complete cases with the Crozat appliance.

The Andresen activator is truly the revolutionary change of our times. A great deal about bone growth and tooth movement will be learned from its use and can be applied to our drawing board of 1964.

In preparing for the future, let us not forget or neglect our glorious past. We are at the crossroads. Fortunately, many of the men who have contributed most to the progress of the science and art of orthodontics are still with us. We who have used and benefited from their appliances should pay tribute to them. It would be nice if our American Association of Orthodontists would have replicas of their appliances beautifully mounted on plaster, acrylic, or metal molds of the teeth, something that will last through the centuries, and present them to the Smithsonian Institution as our contribution to the American spirit of progress.

These appliances have all been valuable steppingstones in the cavalcade of orthodontic progress. We should bring this exhibit up to date by adding appliances by Crozat, Andresen, and others. We know that these, in time, will be merely steppingstones.

Our generation has given cephalometrics by Broadbent, improved removable appliances by Crozat, and activators by Andresen to our specialty of Orthodontics. We can be proud of our progress and our contribution. As orthodontics breaks away from its rudimentary appliances, it will again be exciting, interesting, and gratifying.

SUMMARY

Removable appliances elevate orthodontics to a modern science and orthodontists to a higher level of education, skill, and respect.

The orthodontist, working with two dental assistants and a laboratory man, can handle three times as many patients as is now considered a well-conducted practice. He can do all of this in ten months of the year, as rest periods are important for both the patient and the orthodontist.

With removable appliances there should be no decalcification or gingival irritation, and the teeth do not hurt.

As the appliances are not unsightly and dirty, children are proud of them and treat them as carefully as they would a piece of jewelry.

Removable appliances have opened up an entirely new field of adult orthodontics.

Well-fitting appliances are comfortable and are worn all the time; therefore, they are not lost. Proof of this is the fact that they may be insured at a $100.00 replacement value on each appliance for $5.00 a year or $12.50 for three years. I have several hundred in use, both for active treatment and for retention, and only two patients lost one of their appliances this past year.

The Andresen activator is our answer to mixed dentition cases and satisfies the anxious mother that something good is being done.

With removable appliances, I am able to see the limits of physiologic tooth movement; therefore, I am getting just as beautiful results as in my thirty years of banding teeth. I have hundreds of color slides to substantiate this claim.

Our patients are our friends. The parents hail the advent of removable appliances and I, the orthodontist, daily thank my Maker and Dr. Crozat for my renewed enthusiasm and for the pleasure that I get out of my work.

On your next trip from Sweden to the United States I would like to prove my claims, so I am inviting you to fly to the West Coast and spend a few days or a week or two in my office.

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Department of Orthodontic Abstracts and Reviews

Edited by

DR. J. A. SALZMANN, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City.

Abstracts of Papers Read Before the Research Section of the American Association of Orthodontists, New York, April 29, 1958

Surgical Alteration of Sutural Growth in the Cranium and Face of the Cat: By Carl K. Christian, D.D.S., Eastman Dental Dispensary, Rochester, New York.

This study was designed to determine what effects, if any, the mechanical alteration of known sutural growth sites would have upon the growth of the craniofacial complex of the cat.

Nine 4-week-old cats, separated into groups of three, were utilized for this study. The first cat in each group served as a control for that particular group. The second and third cats in each group were operated upon. While the cats were sedated, lateral and frontal cephalometric roentgenograms were taken and the dates were recorded. In addition, intraoral impressions were taken of the maxillary and mandibular dental arches.

The operative procedures for the second cat in each group consisted of exposing the entire coronal area of the head, including the nasofrontomaxillary suture area. Two sections of bone, each about 1 cm. square, were carefully marked off with calipers. One section included the area of convergence of the frontoparietal sutures; the other was centered in the left parietal bone. These sections were subsequently separated from the cranium and interchanged in position. To complete the procedure, the sutures uniting the maxilla and the nasal and frontal bones were partially obliterated by the use of a large fissure bur. The operative procedure for the third cat in each group consisted of destroying the maxillomalar suture with a large fissure bur.

To facilitate observation of growth increments, Group I was injected at regular intervals with a vital dye, trypan blue. Group II was similarly injected with alizarin red S. Group III was analyzed using decalcified sections and is the group reported on at present.

Preliminary histologic observations indicated that a complete sutural stenosis was not induced by the operative procedure but rather the outlines of the transplanted blocks of bone persisted in the form of incomplete vertical sutures themselves. Visual observations of the casts revealed no intraoral growth aberrations. Histologic and cephalometric evidence seems to indicate that a growth discrepancy may have developed in the cranial area, manifesting itself as a relative excessive anterior-posterior dimension.

The sutures obliterated with a bur recovered their normal morphology and apparently contributed little to the observed cranial irregularity. Furthermore,

the procedure of interchanging sutural areas with nonsutural areas may have led to a partial developmental stenosis and an aberrant pattern of growth.

A Cephalometric Appraisal of Cranial and Facial Relationships at Various Stages of Human Fetal Development: By Jorge C. Mestre, Jr., D.D.S., Eastman Dental Dispensary, Rochester, New York.

A limited study of prenatal human material was undertaken in an effort to add to our present information concerning the complex changes which take place in the development of the head. Lateral roentgenograms were traced and studied to evaluate changes in dimensions of the cranial base, the maxilla, and the mandible, as well as changes in the relationships between upper and lower facial structures.

For this experiment, twenty-four fetuses, ranging in age from 3 months (± 2 weeks) to 9 months (± 2 weeks), were used. They were divided into two main groups as follows: Group I consisted of fifteen specimens from the third and fourth fetal months, and Group II consisted of nine specimens from the seventh, eighth, and ninth fetal months.

When the mean measurements from Group I were compared with those from Group II, the following observations were made: (1) The cranial base angle (basion-sella-nasion) became more obtuse; this seems to result from the combined movement of nasion and basion. (2) The anterior cranial base (sella-nasion) increased relatively more in size than the posterior cranial base (basion-sella). (3) There was evidence to indicate a greater forward positioning of the anterior nasal spine relative to nasion. (4) The posterior nasal spine exhibited a tendency to move proportionately in a downward and forward direction in relation to sella. (5) There was a tendency for the mandible to increase proportionately more than the maxilla in an anteroposterior direction. (6) The gonial angle showed a definite tendency to become more acute with increment in prenatal age.

In conclusion, we can surmise that some of the postnasal changes previously reported are in progress long before birth.

A Comparative Cephalometric Analysis of Nonoperated Cleft Palate Adults and Normal Adults: By Jaime de Jesus, D.D.S., Eastman Dental Dispensary, Rochester, New York.

Skeletal aberrations in surgically repaired cleft palate individuals have been studied by comparing normal and postoperative cleft palate subjects. The primary area of dysplasia has consistently been recognized as the maxilla. It is assumed that the smaller maxillary dimensions in postoperative cleft palate adults result from growth disturbances incurred through surgical procedures. It seems necessary, then, to establish whether or not smaller maxillary dimensions would occur if no surgical procedures were introduced. A comparative analysis of unoperated cleft palate and normal adults offers an opportunity of determining whether there are significant skeletal differences between the two groups.

This preliminary study presents the results of a comparative cephalometric analysis of twenty unoperated cleft palate subjects ranging in age from 15 to 49 years and ten normal subjects ranging in age from 25 to 45 years. Fifteen subjects in the cleft palate group had posterior clefts and five had complete unilateral clefts of the lip and palate. Three of the five in the unilateral group had surgically repaired lips, but none of the cleft palate group had surgical repairs of the palate.

The present data provide an adequate representation of mature skeletal relationships in unoperated posterior cleft palate cases and permit the following conclusions to be drawn:

(1) The proportional height of the maxilla in reference to total facial height was found to be similar in unoperated cleft palate and normal adults.

(2) Proportional measurements between anterior and posterior maxillary heights revealed no significant differences between the two groups.

(3) This was also true when proportional measurements were established for the horizontal dimensions of the maxilla.

(4) Mandibular length and position were also found to be similar in both groups.

(5) Finally, the results of this comparative analysis permit the generalization that the mature skeletal relationships in unoperated posterior cleft cases were not found to differ significantly from those of mature normal persons.

News and Notes

Pacific Coast Society of Orthodontists*

The Northern Component meets on the second Tuesday of March, June, September, and December.

The Central Component meets on the second Tuesday of March, June, September, and December.

The Southern Component meets on the second Friday of March, June, September, and December.

PACIFIC COAST SOCIETY MEETING

The next meeting of the Pacific Coast Society will be held at Rickey's Studio Inn, Feb. 22, 23, and 24, 1960.

NORTHERN COMPONENT

There was no meeting in March. The next meeting will be held in June, 1959.

SOUTHERN COMPONENT

No meeting was held in March. Dr. Charles Linfesty, secretary, announces that Bob Lee has secured Dr. Samuel Pruzansky for the June meeting, and he invites other members of the Pacific Coast Society of Orthodontists to attend the meeting. Beginning at 10 A.M. Dr. Pruzansky will discuss ''Postural Positions and Movements of the Mandible and Contiguous Structures." In the afternoon he will discuss "Abnormal Patterns of Cranial-Facial Development From the Standpoint of Cephalometrics and Its Related Clinical Significance."

CENTRAL COMPONENT

The first quarterly meeting of the Central Component was held on Tuesday, March 10, 1959, at the Fraternity Club in San Francisco.

President Walter Straub turned the meeting over to Program Chairman John Parker, who introduced the clinicians for the afternoon session. Dr. Theo Grant, assistant professor of roentgenology at the University of California College of Dentistry, discussed "Pulpal Changes in Dentition." Dr. Gordon Fitzgerald, professor of roentgenology at the University of California, gave an interesting clinic on Dens-en-Dente. Both clinics were well illustrated by slides and were well received by the members.

Program Chairman Parker then introduced Mr. Robert Lamb, an attorney, who spoke on ''Legal Aspects in Orthodontic Practice.'' His talk was followed by open discussion during which a number of interesting questions were answered.

*Excerpts from the *Bulletin* of the Pacific Coast Society of Orthodontists, April, 1959.

American Dental Association
Forum on Orthodontics

A forum on orthodontics will be presented at the annual meeting of the American Dental Association in New York City Sept. 14 to 18, 1959. The forum will be under the direction of Dr. William R. Root, chairman of the Orthodontic Section. The program follows.

Diagnosis

(Monday, September 14. Harry D. Spangenberg, Jr., Presiding)

Panel Discussion: Diagnosis of Difficult Cases.

Moderator: LeRoy Ennis, Philadelphia, Pennsylvania.

Panelists: H. Stones, Liverpool, England.
A. Benagiano, Rome, Italy.
J. J. Pindborg, Copenhagen, Denmark.

Orthodontics

(Tuesday, September 15. William R. Root, presiding)

Individual Essays:

Serial Extraction as Treatment Procedure.
Z. Bernard Lloyd, Washington, D. C.

Supernumerary and Congenitally Missing Teeth.
Frank P. Gilley, Bangor, Maine.

Denver Summer Seminar

The program for the Denver Summer Seminar, which will be held at Writer's Manor in Denver, Colorado, Aug. 2 to 7, 1959, has been announced. The following will be featured:

Samuel Davis Gore, D.D.S., F.I.C.D., F.A.C.D., New Orleans, Louisiana, Associate Professor of Orthodontics at the University of Alabama School of Dentistry.

Topics of Discussion:

History of the Precious Metal Removable Appliance. (Preparation of models, trimming of teeth to correct anatomic form for clasps, and construction of the appliance will be discussed and illustrated by slides.)

Psychological Preparation of the Patient for Wearing Removable Appliances—

Advantages and Disadvantages in Their Use. (Instructions to the patient on care of appliances, again stressing the importance of cooperation. Treatment of cases illustrated by slides.)

Treatment of cases continued with emphasis on treatment in deciduous dentition.

Table clinic showing auxiliary attachments and adjustment of appliances for various tooth movements.

Dr. Nathan Kohn, Jr., St. Louis, Missouri.

Topics of Discussion: (To be announced.)

Harry Sicher, M.D., D.Sc., Professor and Head of Department of Anatomy, Loyola University, Dental School, Chicago, Illinois.

Topics of Discussion:

Growth of Skull and Face.
General Principles of Skeletal Growth.
Methods of Investigation and Their Limitations.
Biologic Consideration of Cranial and Mandibular Growth.
Outlook to Etiology of Malocclusions.

Entertainment has not been neglected. This consists of the annual supper on the evening of August 2 for all in attendance. Members of the twenty-second annual meeting and their families will enjoy famous old Central City and dinner at the historic Teller House, followed by a play in the Opera House, on Tuesday evening.

A cool, refreshing scene just outside Aspen, Colorado, where the Rocky Mountain Society of Orthodontists will hold its thirty-ninth annual meeting Sept. 13 to 16, 1959. The facilities of the Aspen Institute at Aspen Meadows, managed by the Hotel Jerome, will be used.

Please make hotel reservations directly with Writer's Manor, 1730 S. Colorado Blvd., Denver, Colorado. Mention that you are with the Denver Summer Meeting, as a block of rooms are reserved for our group. It is the opinion of the Board of Trustees that Writer's Manor will afford the finest of accommodations, as it has in the past. It has a variety of eating places, excellent food, air conditioning, a swimming pool, and a minimum of noise.

A printed program will be mailed at a later date to those sending in applications, indicating attendance. A fee of $30.00 is requested with your application. Should you be unable to attend, this fee will apply to the purchase of a book containing the full proceedings of the meeting.

Attendance is limited, and applications will be given preference in the order of their return.

Eli H. Mullinax, Secretary
8790 West Colfax Ave.
Denver 15, Colorado

American Dental Association*

BRIEFS IN THE NEWS

A. D. A. members are invited to the seventh annual National Civil Defense Conference to be held June 6 in Atlantic City at the Traymore Hotel. Information about the program, to be presented by the Army Medical Service under the auspices of the A. M. A. Council on National Defense, can be obtained from the A. D. A. Council on Federal Dental Services. . . . Dr. Lester Burket, of Philadelphia, chairman of the A. D. A. Council on Dental Therapeutics, will represent the Association at the keynote session of the convention of the National League for Nursing to be held May 11-15 in Philadelphia. . . . For the first time in 13 years, the Canadian Dental Association will hold its national convention in Nova Scotia. The meeting will take place June 21-24 at the Nova Scotia Hotel in Halifax. . . . The potentialities of a future International Health Year will be a principal topic at the 2nd National Conference on Health sponsored by the National Citizens Committee for the World Health Organization, May 7-9, at the Statler-Hilton Hotel in Washington, D. C. Dr. Harold Hillenbrand, of Chicago, A. D. A. secretary, is a member of the organization's board of directors. . . . Fourteen new research grants amounting to $126,251 were awarded by the National Institute of Dental Research in March. . . . If forced to choose between spending money for health research or "putting the first man on the moon," an overwhelming majority of Americans would give dollars to research, according to a survey of space age opinion made for the National Association of Science Writers by the University of Michigan Survey Research Center. The report is entitled "Satellites, Science and the Public."

DEPENDENT DENTAL CARE AT BASES OR PRIVATE OFFICES AUTHORIZED IN BILL

A bill to provide additional dental care for military dependents was introduced in the House of Representatives last week by Rep. Price (D., Ill.). It was the second measure involving dental care for dependents that was presented to Congress this spring. Earlier, Rep. Dent (D., Penn.) introduced a bill to provide "on-the-base" care for dependents. The newest measure would amend the Medicare Act to: (1) authorize "complete dental care" in armed forces facilities, subject to the availability of space and facilities and the capabilities of the dental staff; (2) require the Secretary of Defense to contract for dental care for dependents "under such insurance, dental service or dental health plan as he considers appropriate." On the second point, partial payment would be required for dependents over the age of 16. There would also be moderate charges for care at military

*From the A.D.A. *News Letter*, May 1, 1959.

bases. Dependents would be permitted to choose care at bases or from a civilian dentist. The bill was referred to the House Armed Services Committee of which Rep. Price is a ranking member. It was considered possible that the measure was inspired unofficially by the Air Force to test reaction. Rep. Price has said that the proposal "is designed to complete the health program for military families." The A. D. A. House of Delegates last November questioned the desirability at the present time of making dental health benefits available to military dependents under a federally financed program and requested a further report on the whole subject to be presented at the 1959 meeting in New York in September.

Correction

Due to a misunderstood Post Office note, it was erroneously reported that Dr. Barney B. Kennedy of Jackson, Mississippi, had died. We are glad to announce that Dr. Kennedy is very much alive and well.

Notes of Interest

Maurice E. Masters, D.D.S., announces the removal of his office to 589 Third Ave., Chula Vista, California, practice limited to orthodontics.

Frederick M. Moynihan, D.M.D., takes pleasure in announcing the association of Daniel A. Mitchell, D.D.S., for the exclusive practice of orthodontics at 400 Union Ave., Framingham, Massachusetts.

Mary Jane Peaks, D.D.S., announces the opening of offices at 81 Nassau Blvd., Garden City, New York, practice limited to orthodontics.

Irving N. Schuster, D.D.S., announces the opening of his office for the practice of orthodontics at 29 Sunset Blvd., Harbour Green, Massapequa, New York.

Forthcoming meetings of the American Association of Orthodontists:
1960—Shoreham Hotel, Washington, D. C., April 24 to 28.
1961—Denver, Colorado.
1962—Los Angeles, California.
1963—American Hotel, Miami Beach, Florida.

OFFICERS OF ORTHODONTIC SOCIETIES

The American Journal of Orthodontics is the official publication of the American Association of Orthodontists and its component societies. The Editorial Board of the Journal is composed of a representative of each of the component societies.

American Association of Orthodontists
(Next meeting April 24-28, 1960, Washington)

President, C. Edward Martinek - - - - - - - - - - - Fisher Bldg., Detroit, Mich.
President-Elect, George M. Anderson - - - - - - - 3700 N. Charles St., Baltimore, Md.
Vice-President, Ernest N. Bach - - - - - - - - - - Professional Bldg., Toledo, Ohio
Secretary, Earl E. Shepard - - - - - - - - - - - - - 8230 Forsyth, St. Louis, Mo.

Central Section of the American Association of Orthodontists
(Next meeting Sept. 28 and 29, 1959, Chicago)

President, John R. Thompson - - - - - - - - - - 55 E. Washington St., Chicago, Ill.
Secretary-Treasurer, William F. Ford - - - - - - - 575 Lincoln Ave., Winnetka, Ill.
Director, Elmer F. Bay - - - - - - - - - - - - 216 Medical Arts Bldg., Omaha, Neb.

Great Lakes Society of Orthodontists
(Next meeting Nov. 29-Dec. 2, 1959, Cleveland)

President, Richard C. Beatty - - - - - - - - - - - 1140 Hanna Bldg., Cleveland, Ohio
Secretary, D. C. Miller - - - - - - - - - - - - - 40 South Third St., Columbus, Ohio
Director, Harlow L. Shehan - - - - - - - 601 Jackson City Bank Bldg., Jackson, Mich.

Middle Atlantic Society of Orthodontists
(Next meeting Oct. 4-6, 1959, Washington)

President, Stephen C. Hopkins, Sr. - - - - 1746 K St., N. W., Washington, D. C.
Secretary-Treasurer, Charles S. Jonas - - - - - - Mayfair Apts., Atlantic City, N. J.
Director, B. Edwin Erikson - - - - 3726 Connecticut Ave., N. W., Washington, D. C.

Northeastern Society of Orthodontists

President, Wilbur J. Prezzano - - - - - - - - - Medical Centre, White Plains, N. Y.
Secretary-Treasurer, David Mossberg - - - - - 36 Central Park S., New York, N. Y.
Director, Norman L. Hillyer - - - - - - - - 230 Hilton Ave., Hempstead, L. I., N. Y.

Pacific Coast Society of Orthodontists

President, Richard Railsback - - - - - - - - - - 1333 Grand Ave., Piedmont, Calif.
Secretary-Treasurer, Warren Kitchen - - - - - - 2037 Irving St., San Francisco, Calif.
Director, Richard Railsback - - - - - - - - - - 1333 Grand Ave., Piedmont, Calif.

Rocky Mountain Society of Orthodontists
(Next meeting Sept. 13-16, 1959, Aspen, Colo.)

President, Howard L. Wilson - - - - - - - - - - 1107 Republic Bldg., Denver, Colo.
Secretary-Treasurer, E. H. Mullinax - - 209 Lakewood Medical Center, Lakewood, Colo.
Director, Ernest T. Klein - - - - - - - - - - - 632 Republic Bldg., Denver, Colo.

Southern Society of Orthodontists
(Next meeting Oct. 11-14, 1959, Atlanta)

President, H. Harvey Payne - - - - - - - - - - - 60 Fifth St., N.E., Atlanta, Ga.
Secretary-Treasurer, William H. Oliver - - - - - - - 1915 Broadway, Nashville, Tenn.
Director, Boyd W. Tarpley - - - - - - - 2118 Fourteenth Ave., S., Birmingham, Ala.

Southwestern Society of Orthodontists
(Next meeting Oct. 4-7, 1959, Houston)

President, Marcus Murphey - - - - - - - - - - 2017 West Gray, Houston, Texas
Secretary-Treasurer, Harold S. Born - - - - - - 908 S. Johnstone, Bartlesville, Okla.
Director, Nathan Gaston - - - - - - - - - - - - - - 701 Walnut St., Monroe, La.

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